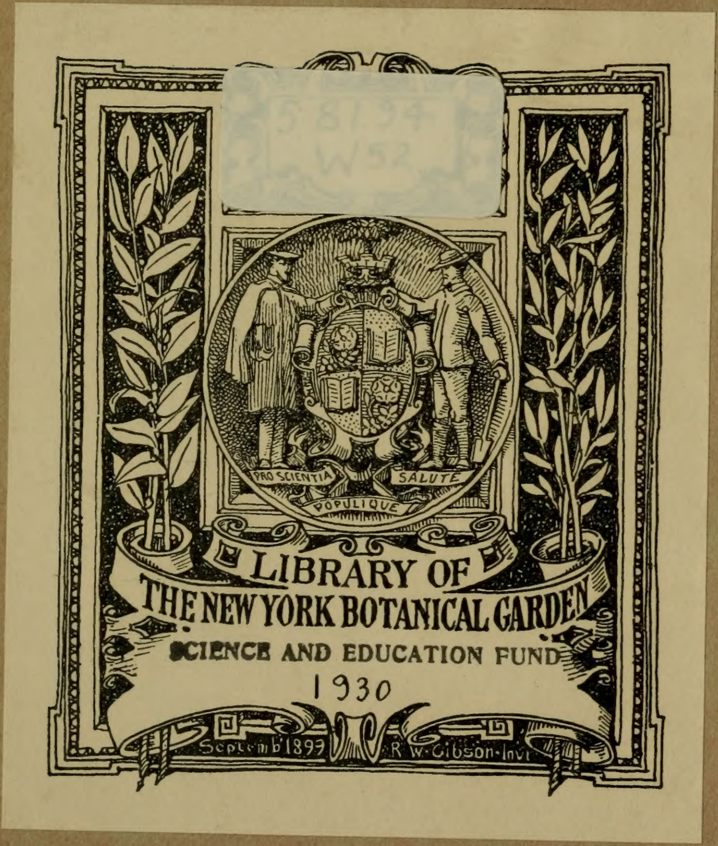

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[*Continued on page* iii *of Cover.*

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VI.—A Further Contribution to a Comparative Study of the dominant Phanerogamic and Higher Cryptogamic Flora of Aquatic Habit in Scottish Lakes. By George West. (With Sixty-two Plates.)

SCOTTISH LAKE SURVEY.

Under the direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., LL.D., etc., and LAURENCE PULLAR, F.R.S.E.

(MS. received June 1, 1909. Read July 12, 1909.)

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PART I.—INTRODUCTION.

THIS contribution is a continuation of a former paper* on the same subject, references to which in this paper will, for the sake of brevity, be referred to as *ante*, p. . . . , or *ante*, fig. . . . The present pages deal especially with the following districts of Scotland:—

1. North-west Kirkcudbrightshire.
2. South-east Kirkcudbrightshire.
3. Wigtownshire.
4. Fife and Kinross.

1. **The Lochs of Kirkcudbrightshire** may be advantageously divided into two Areas by a line passing from Gatehouse of Fleet across the country in a north-easterly direction towards Thornhill in Dumfriesshire. All the

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* "A Comparative Study of the dominant Phanerogamic and Higher Cryptogamic Flora of Aquatic Habit in Three Lake Areas of Scotland," *Proc. Roy. Soc. Edin.*, session 1904–5, vol. xxv., part xi., pp. 967–1023, and 110 illustrations.

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lochs in Kirkcudbrightshire north-west of this line, including those on the border of Ayrshire, in the neighbourhood of Loch Doon, are mostly of the nature of highland lochs. This district is characterised by mountain and moor; indeed, some of the highest mountains in Scotland, south of Perthshire, are found here. The lonely grandeur of its wild scenery, notwithstanding the paucity of purple heather, gives it rank amongst the foremost of Scotland's charms. Owing to the lack of good roads, the absence of footpaths, and the exceedingly rough and often impassable nature of the ground, the tourist seldom penetrates to the remote fastnesses where lies the wildest of the fascinating scenery. The mountains, for the greater part rounded and reduced by intense glaciation, are, where the rock is not altogether bare of soil, covered with grass-like associations of plants which afford pasturage to enormous numbers of sheep. The predominance of grass-like associations over the mountains and moors, instead of heather, has a great and important influence upon the flora of the lochs. Not only that, but the pastoral life induced thereby stamps the inhabitants with characteristics different from those of the people living in localities that are chiefly devoted to sport, and engenders a higher type of ethics and a superior social organisation amongst the rural folk.

In the district of New Galloway, and in fact throughout the country for miles around, there are a few abundant plants that form a characteristic feature of this neighbourhood. They are as follows:—Jasione montana and Lepidium heterophyllum in dry places; Carum verticillatum and Œnanthe crocata in damp and wet places.

In continuity with a former contribution (*ante*, p. 971), I here call this district Area IV. (pp. 100–127, figs. 1–45).

2. **South-east of the line** from Gatehouse to Thornhill, the lochs of Kirkcudbrightshire are chiefly of a lowland type, and the district is almost wholly agricultural. The land is frequently very rich, and the farmers are prosperous and noted for their wealth. There are comparatively few lochs, and the undulating and often well-wooded country is frequently beautiful. This district I term Area V. (pp. 127–136, figs. 46–58).

3. **Wigtownshire** is remarkable for its great tracts of treeless, monotonous and dreary peat moor. In comparison with the adjoining district of north-west Kirkcudbrightshire, almost the whole county appears flat and tame. The relaxing and enervating atmosphere of south-east Kirkcudbrightshire is here in many places intensified. Agriculture is the dominant industry, particularly dairy-farming, and beyond the intractable moss-hags the land is frequently very rich. Those sheets of water that are situated on the open moors resemble highland lochs in their general features. Those lakes

that are within the zone of active agriculture are decidedly of the lowland type. Wigtownshire I term Area VI. (pp. 136–147, figs. 59–82).

The geological structure of Kirkcudbrightshire and Wigtownshire is not very diversified. A line drawn from Glenluce in a north-easterly direction, passing through Dalry and thence to Moniaive, would roughly divide these counties into two geological sections—Lower Silurian N.W. of the line, and Upper Silurian S.E. of it. Three large areas of intrusive rocks, chiefly granite, occur (1) in the Lower Silurian, extending from the neighbourhood of Loch Doon to Loch Dee, and embracing the range of mountains of which Merrick (2674 feet) is the highest point; (2) in the Upper Silurian, forming the range of hills of which Cairnsmore of Fleet (2331 feet) is the highest, and embracing Loch Grennoch; (3) and again in the same section, at and to the S.E. of Dalbeattie, the culminating point of this group being Criffel (1886 feet). Other formations, such as Carboniferous, Triassic, and Recent, also occur, but only in few places, and over comparatively restricted areas.

4. **In Fife and Kinross** a few lochs of a semi-highland character may be found on the higher hills. The greater number of the lochs in this district, however, are distinctly of a lowland type, and many of them have a very rich flora, comparatively rare plants often occurring in great abundance. The central and western portion of Fife is renowned as a coal-producing district; and whilst thousands of the inhabitants enrich themselves by bringing mineral wealth from the bowels of the earth, others, nearly everywhere, are actively engaged in agricultural operations. The rich soil readily responds to the methods of modern farming, and even many of the less favourable spots are, under the stimulus of scientific treatment, made to grow valuable crops, instead of being relegated to the unproductive realms of sport. Besides this, numerous manufacturing industries are carried on upon a large scale in many places, and the great extent of seacoast gives occupation to a considerable number of fisher folk. This Area is therefore, in comparison with the others, a densely populated one, and the greater number of its lochs have had their natural features considerably altered by the hand of man. Suitably situated lakes have been converted into reservoirs for providing the larger towns and villages with water. In some parts, especially in East Fife, the public water supply presents a serious problem that has not always been satisfactorily solved, owing to the comparatively small rainfall and the absence of suitable water in the form of lochs or streams. As an example of this difficulty, it may be mentioned that the water supply for the Newport district is brought across Strath More, the Sidlaw Hills, and the Firth of Tay, from Lintrathen in Forfarshire. In some parts new lochs have been created by the construction of

dams, etc. In other places, shallow sheets of water that could be put to no useful purpose have been drained and the sites utilised for agriculture, whilst in a few cases lochs are used as receptacles for sewage. The only lochs of this Area that retain their natural conditions are the smaller ones on the Cleish Hills.

The Carboniferous and Old Red Sandstone series of rocks, which largely prevail, have in a former epoch suffered considerable contortion from volcanic activities, and large areas are covered with lavas, tuffs, and dolerite sills. Suffice it to mention Burntisland Bin, Largo Law, May Island, and Norman's Law as eloquent monuments of that period. The country is hilly, but not mountainous; yet in many parts the scenery is beautiful: instance the undulating country to the west of Loch Leven and of the Howe of Fife, or the charming scenic effect produced by the rapid alternation of hill and dale in the neighbourhood of Aberdour, Burntisland, Newburgh, and Newport. Contrast the weird monotony of the flat links of Tents Muir with the bold perpendicular craigs of the Isle of May. Contemplate the picturesque grandeur of the Firth of Tay, equalled, but not surpassed, by the vaster expanse of beauty afforded by the lower reaches of the Firth of Forth. Turn from the grimy atmosphere of the sordid mining villages, and from odoriferous Kirkcaldy, to the wilder portions of the Lomond, Cleish, and the eastern slopes of the Ochil Hills, where one is forcibly reminded that Philistia has not yet completely triumphed over the rural glories and natural monuments of Fife and Kinross.

It is more convenient to treat these counties as one district than to divide them into natural drainage areas; I therefore make this region Area VII. (pp. 147–177, figs. 83–124).

In this investigation an endeavour has been made to record the dominant and abundant plants of the lakes visited, together with some observations upon the environmental conditions under which they grow.* These papers may therefore be considered as being floristic rather than ecological; they also present a number of necessary although brief remarks on the topography and physiography of the districts, as well as some notes from an ecological standpoint. The main idea running through this presentation is that of laying before the reader a plain account, from a botanical aspect, of the lochs, and the plants that grow in them and on their shores, keeping in view the fact that the work is a part of the Survey of the Fresh-water Lochs of Scotland. These papers may further be regarded as a preliminary step towards future fieldwork of a distinctly ecological character which may possibly be carried on by the writer. It is hoped, however, that others may be led by the perusal of these pages to some of the many sites enumerated, where Nature seems ready, nay, anxious, to reveal some secret to the earnest investigator.

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* A summary of such conditions occurring in the Ness Area may be found in the *Geographical Journal*, January 1908, pp. 67–72.

Although a good many additions have been made to the vice-counties—73, 74, 75, 85, 96, and 97 in *Topographical Botany*—still, no special search has been instituted for the purpose of adding records to a county list; at the same time it is frequently shown that comparatively rare species occur at many of the lochs in great abundance. As a general rule, I have only been able to visit each loch once, sometimes working over three or four small ones in a day; at other times spending two, three, or more days at one large loch. Thus have I not only been obliged to ignore seasonal changes, but have conducted the work almost irrespective of weather, although wind or rain seriously handicaps one.* Under such circumstances some plants have probably been overlooked. It will therefore be readily understood that I am not prepared to say that certain species do not exist in certain places, or to refute in any way the records of other botanists. Rather the opposite, for I am quite ready to admit the occurrence of plants not found in my list in the lochs that have been examined, especially in the case of plants that live entirely submersed, even though such may be abundant. One has also to remember the comparatively rapid changes that may take place in the flora of a loch, particularly amongst the plants that seldom occur very plentifully. Again, when the large districts that I have gone over in one season are held in contemplation, the most energetic of botanists will admit the impossibility of examining with microscopic vision, in so short a time, every nook and corner of the margin as well as the bottom of every lake visited. Neither is such minute examination a necessary concomitant to the wider purposes of the investigation, as expressed by the title. Further, the omission of a plant from the list does not by any means necessarily imply that it is absent in the Area, but merely that I did not find it in abundance at any of the lochs. I have simply recorded exactly what I have observed.

My friend Mr James M'Andrew, of Edinburgh, who resided many years in Kirkcudbrightshire, and whose discoveries in the geographical distribution of plants have so greatly enriched the written records of the flora of this and the adjoining counties, especially amongst the Cryptogams, has rendered me many services. Naturally he has had opportunities of observation that have been denied to me; the records that he has kindly furnished, where my own were deficient, are acknowledged by being placed in brackets, with his initials.

---

* Those who have not had experience in such or similar boating operations during windy weather can scarcely appreciate the difficulty of carrying on the work, even under an ordinary stiff breeze.

The observational work for this paper was done in the field chiefly during the summer and autumn of 1905. The preparation for the press has been considerably retarded by other duties; hence the delay in the publication of the paper, for which I apologise.

Since the first part of this contribution was written a number of changes in nomenclature have been suggested. As it would appear to savour of inconsistency, besides adding an element of confusion, to give the same plant a different name in the second part of a publication to that which it bore in the first part, I have acknowledged the change in most cases by adding the new name in italics enclosed by brackets, after the old name, in the Systematic List of Plants.

In order to facilitate comparison, I have included in the succeeding Systematic List of Plants the numerals that represent the Areas discussed in a former contribution (*ante*, p. 971); a few plants, however, are enumerated there that are not mentioned in this paper. The whole of the Areas at present examined are therefore included in the following list, and the occurrence of the plants in each of the seven Areas investigated is indicated by the numerals after the authority, viz.—

I. The Ness Area.
II. Island of Lismore.
III. Lochs of Nairn.
IV. N.W. Kirkcudbrightshire.
V. S.E. Kirkcudbrightshire.
VI. Wigtownshire.
VII. Fife and Kinross.

The remarks after the numerals in the following list, unless especially indicated, refer only to Areas IV. to VII. inclusive. I hope to deal in a future contribution with the internal and external morphology of some of the plants; such matters are therefore excluded from the present pages.

PART II.—SYSTEMATIC LIST OF THE PLANTS.

RANUNCULACEÆ.

Ranunculus aquatilis, *L.* IV., V., VI., VII. Many forms of the aquatic Batrachian Ranunculi occur in the lowland non-peaty lochs of the districts now under discussion. Occasionally it was quite impossible to determine the exact species met with, owing to the absence of flowers and fruit, or other data by which the numerous forms are distinguished. The species enumerated below I have been able to collate with published descriptions. In the local lists contained in this paper, when R. aquatilis is given, it will be understood that it has not been possible to distinguish the exact species, for the reasons just mentioned. All forms are very scarce in Areas I. to III.

Ranunculus Drouetii, *F. Schultz.* V., VI., VII. Not very general; occurring chiefly in small lowland lochs.

Ranunculus Baudotii, *Godr.* VII. Not common, but occasionally abundant.

Ranunculus circinatus, *Sibth.* "II. Very scarce." VI., VII. Not general, but occasionally very abundant: at Kilconquhar Loch, for example, it covers a large area of the water, and, with the preceding species, presents a magnificent spectacle when in flower (fig. 92).

Ranunculus peltatus, *Schrank.* V., VI., VII. Widely distributed, and although not a common loch plant, is occasionally very abundant. Sometimes a terrestrial form overgrows mud at the margin of a loch, as at the west end of Kinghorn Loch. At L. Camilla, Fife, there is a curious form with dark spots and blotches on its lobed floating leaves, similar to those on the leaves of R. hederaceus; the latter is also abundant at L. Camilla.

Ranunculus heterophyllus, *Weber.* IV., V. Occasionally very abundant. In Loch Ken, for instance, it overgrows considerable tracts of shallow water at the margin of the loch, and when in flower is extremely picturesque (figs. 37 and 38).

Ranunculus Lenormandi, *F. Schultz.* V. On mud at the margin of lakes, but very scarce. [VI. In ditches S. of Lows Warren.—J. M'A.]

Ranunculus hederaceus, *L.* "I. Very scarce." VII. Frequent on the muddy shores of lochs. In Areas IV., V., and VI. it is frequent about streams, etc., but is seldom seen at the lochs.

Ranunculus sceleratus, *L.* VII. On muddy shores, but very scarce.

Ranunculus Lingua, *L.* V., VII. On marshy ground about lowland lochs; restricted in distribution, but abundant where it does occur.

Ranunculus Flammula, *L.* "I., II., III. Abundant." IV., V., VI., VII. Normal forms are abundant nearly everywhere below 1000 feet above sea level.

Ranunculus scoticus, Marsh. "I. Abundant about the shores of lochs over 1000 feet above sea." IV. Occurs at some of the hill lochs.

Ranunculus Flammula, *L.* A small prostrate form rooting profusely at the nodes, similar to the var. pseudo-reptans but larger, is sometimes found upon the stony or sandy shores of lochs in all the Areas, but is especially abundant at Loch Ken (figs. 39 and 40).

Ranunculus Flammula, *L.*, var. pseudo-reptans, *Syme.* VII. A very small prostrate plant, somewhat resembling the true R. reptans. Occasionally found on exposed shores.

Ranunculus reptans, L. VII. Perhaps another district form of R. Flammula. It occurs on flat, exposed, sandy places that are either bare or covered with short herbage in various spots all around Loch Leven. It is also abundant at Carriston Reservoir (fig. 94), and occurs sparingly at the reservoirs on the Lomond Hills. The filiform stem usually has from 3 to 5 vascular bundles in the lowest internode, but occasionally as many as 12 may be found. The smallest forms of the var. pseudo-reptans have thicker stems containing more vascular bundles which are also better developed. The dwarf prostrate growth assumed by this plant is also exhibited by other plants on the exposed shores of Loch Leven,—for example, Juncus acutiflorus, J. bufonius, Equisetum arvense, E. palustre, Carex hirta, etc.

Ranunculus Flammula, *L.*, var. natans, *Pers.* IV., VII. I have found two distinct forms of this interesting variety. (1) In Area VII., a floating form which is abundant at the margin of peaty pools about Morton Lochs, Tents Muir. This is a rather strong, wiry plant 2 or 3 feet long, having leaves somewhat thinner in texture than those of the terrestrial type, but by no means flaccid; it otherwise resembles the weak flaccid form described below. This is probably the exact form described by Persoon * and Lamarck. † (2) In Area IV., a submersed plant growing at the margin of lochs and in slow streams, in water 6 to 24 inches deep. The floating stem, 12 to 30 inches long, has at every node elongated roots and a fascicle of leaves. The radical leaves are few, and have a slender petiole 3 to 8 inches long, with a small entire ovate or elliptical lamina ½ inch to 1 inch long. The stem leaves are similar to the radical ones, but smaller, more linear, and float more or less upon the surface. No specimens were found in either flower or fruit, perhaps owing to the lateness of the season (September). The whole plant is weak and flaccid when withdrawn from the water. It is very abundant in the neighbourhood of Lochs Recar, Ballochling, etc. It cannot, therefore, be treated as a mere "sport," but rather as an aquatic form of R. Flammula. From this aspect it is most interesting, as it presents a case of an aquatic plant derived from a common semi-aquatic or almost terrestrial progenitor, and the form from Tents Muir may be considered as an intermediate stage in the evolutionary process.

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* "Ranunculus . . . . . .
2. *Flammula* . . . . . .
. . . . γ. *natans*, fol. inferiorib. ovatis integris, superiorib. linearibus. In aquis prope Montmorency et in Barbaria. Vid. Lam. Enc. bot. 6. p. 98–99." (*Synopsis Plantarum*, ... C. H. Persoon, vol. ii. (1807), p. 102.)

† "On trouve dans l'étang de Montmorency une varieté très-voisine de celle-là,

Caltha palustris, *L.* "I., II., III.," IV., V., VI., VII. An abundant plant about lowland lochs, especially in Area VII.

Caltha palustris, *L.*, var. minor, *Syme.* "I.," IV. About the hill lochs, see remarks *ante*, p. 971.

NYMPHÆACEÆ.

Castalia speciosa, *Salisb.* (= *C. alba, Wood*). "I., II.," IV., V., VI., VII. Very common and abundant, especially where the water is not very peaty (figs. 21, 61, 86, 87, etc.).

Castalia speciosa, *Salisb.*, var. minor (*DC.*). "I.," IV. Less abundant than in Area I.; see remarks *ante*, p. 971.

Nymphæa lutea, *L.* "II.," IV., V., VI., VII. Common and abundant, often overgrowing large areas, but seldom seen in the hill lochs (figs. 31, 87, etc.).

Nymphæa lutea, *L.*, var. intermedia (*Ledeb.*). IV., VII. Grows with the larger form, and sometimes alone, particularly in the lower portion of L. Ken, where it is very abundant. Rather rare in Area VII.

Nymphæa pumila, *Hoffm.* "I.," IV. Not common; chiefly in L. Ken and L. Stroan.

plus grande, nageant à la surface de l'eau, dont toutes les feuilles sont entières, les inférieures ovales, obtuses, portées sur de très-longs pétioles ; les supérieures étroites, linéaires, aiguës ; les pédoncules presqu'uniflores" (*Lam. Encyc.*, vol. vi. (1804), pp. 98–99).

CRUCIFERÆ.

Radicula officinalis, *Groves* (=*R. Nasturtium-aquaticum, R. and B.*). "II., III.," V., VI., VII. Seldom abundant at the lakes.

Radicula palustris, *Moench.* V., VI., VII. Occurring sporadically about the shores of lowland lakes.

Radicula pinnata, *Moench* (=*R. sylvestris, Druce*). V. Distribution very restricted.

Cardamine pratensis, *L.* "I., II., III.," IV., V., VI., VII. Almost ubiquitous, but generally sparse. A form which multiplies vegetatively by buds, that arise from the base of the leaflets, occurs at Loch Gelly (p. 160).

Subularia aquatica, *L.* "I." A few plants occasionally observed. IV., V., VI. Often very abundant.

VIOLACEÆ.

Viola palustris, *L.* "I., II., III." Only as scattered specimens upon the shores of lakes. IV., V., VI., VII. Frequent in lowland situations.

ELATINACEÆ.

Elatine hexandra, *DC.* VI. Very abundant in some places. At Loch Magillie and White Loch, Castle-Kennedy, for example, this plant carpets the bottom in large patches from the margin to a depth of 6 feet. At other lochs it sometimes covers an exposed muddy shore. When submersed the plants are of a delicate texture, pale green, with elongated leaves, and seldom produce flowers. When exposed on mud or sand they are much more robust, dark-reddish green, with short leaves, and flower profusely. In the latter state the specimens much resemble small examples of Peplis Portula in both form and colour.

CARYOPHYLLACEÆ.

Sagina nodosa, *Fenzl.* VII. In matted growth on sandy or stony shores; scarce.

Stellaria uliginosa, *Murr.* "I., II., III.," IV., V., VI., VII. Widely distributed, but seldom abundant.

Stellaria palustris, *Retz.* V. Scarce.

HYPERICACEÆ.

Hypericum humifusum, L. V. Wet sandy and gravelly shores, not common, and usually a straggler from an adjoining heath.

Hypericum elodes, *L.* IV., [V.—J. M'A.], VI. Sometimes very abundant, but always in peaty water (fig. 26).

ROSACEÆ.

Spiræa Ulmaria, *L.* "I., II., III.," IV., V., VI., VII. Widely distributed and frequently very abundant, but chiefly about lowland lakes (fig. 98).

Comarum palustre, *L.* (=*Potentilla palustris, Scop.*). "I., II., III.," IV., V., VI., VII. Remarks the same as to the last-mentioned plant.

LYTHRACEÆ.

Peplis Portula, *L.* "I.," IV., V., VI., VII. Aquatic and terrestrial forms are common about the shores of lochs, but chiefly lowland. The ordinary fragile form is mostly met with, but at Loch Barhapple a very large and stout terrestrial form grows abundantly in large, flat, spreading patches over the muddy shore; many of these patches, consisting of but one plant, were more than a foot in diameter. Opposed to the latter, at the south end of Loch Doon, an entirely submersed form was very abundant, growing to a depth of 3 feet. The leaves of these were much larger, thin, and semi-pellucid, stems weak and considerably elongated.

Lythrum Salicaria, *L.* "II.," IV., V., VI., VII. Frequently very abundant on the shores of lochs, chiefly lowland, but rare in Area VII. (fig. 74).

ONAGRACEÆ.

Epilobium angustifolium, *L.* "I," VI. Very scarce at the lochs.

Epilobium palustre, *L.* "II.," VI., VII. Usually with other herbage in marshy places on the shores of lochs.

Epilobium tetragonum, *L.* IV., VII. Remarks same as to the last mentioned, but this is a less frequent species, and is generally scarce.

Epilobium hirsutum, *L.* "I," VII. Seldom abundant, but occasionally dominant over a small area of marshy shore. Of common occurrence in ditches and by rivers.

HALORAGACEÆ.

Hippuris vulgaris, *L.* "I., II., III.," [V., VI.—J. M'A.], VII. Occasionally very abundant, but always in lowland lochs (fig. 90).

Myriophyllum alterniflorum, *DC.* "I., III.," IV., V., VI., VII. Generally very abundant, but it usually seems to require water that is more or less peaty. In lowland non-peaty lochs that receive the drainage from cultivated land, M. spicatum as a rule takes its place. It is exceptional to find the two species in the same water.

Myriophyllum spicatum, *L.* "II.," V., VI., VII. Abundant where the water is not peaty; see remarks on the preceding species.

CALLITRICHACEÆ.

Callitriche vernalis, *Koch* (= *C. palustris, L.*). VI., VII. Rare at the lochs, but it sometimes occurs in sheltered bays or in shore pools.

Callitriche stagnalis, *Scop.* "I., III.," IV., V., VI., VII. Terrestrial and aquatic forms are rather common in shallow places and pools about the shores of non-peaty lowland lochs. When growing on a muddy or sandy shore the plants are rather sturdy, and form sward-like, spreading tufts. When submersed they are weaker, with leaves and internodes elongated.

Callitriche hamulata, *Kütz.* (= *C. intermedia, Hoffm.*). "I., III.," IV., V., VI., VII. Widely distributed in peaty lochs, but nowhere so generally abundant as in Area I. It is usually found without the floating rosettes, but in a few places, Loch Stroan for example, the two forms occur. When rosettes are present, the floating, spathulate, apical leaves gradually become transformed downwards into the linear type, and from about 3 inches below the apex all the lower leaves are linear and emarginate, as in the form without the floating rosettes.

Callitriche autumnalis, *L.* V., VI., VII. This fine species is widely distributed in non-peaty lowland lochs, and is frequently very abundant. At Soulseat Loch, for example, this plant and Ranunculus circinatus are the only submerged Phanerogams that are plentiful. Again, at Carlingwark and Kilconquhar Lochs, notwithstanding strenuous competition by more robust rivals, this plant maintains a dominance over certain portions of the bottom. This species varies somewhat in the form of leaf and fruit.

PORTULACEÆ.

Montia fontana, *L.*, and its aquatic form, var. rivularis, *Gemel.* "I., II.," V., VI., VII. A very common plant about the shores of some of the less peaty lochs in both aquatic and terrestrial forms.

SAXIFRAGACEÆ.

Parnassia palustris, *L.* "I., II.," IV., [V., VI.—J. M'A.], VII. Occasionally represented on boggy shores.

UMBELLIFERÆ.

Hydrocotyle vulgaris, *L.* "I., II., III.," IV., V., VI., VII. The ordinary form abounds nearly everywhere on the shores of lochs (*ante*, fig. 36). At Barlockhart Loch there occurred a floating form having stems from 30 to 50 inches long, with leaves only about ½ inch in diameter and very thin.

Apium nodiflorum, *H. G. Reichb.* V., VII. Scarce, seldom seen as a constituent of a loch flora.

Apium inundatum, *H. G. Reichb.* "I.," IV., V., VI., VII. Sometimes very abundant, but always in water that is not very peaty. It usually occurs from the margin to 3 feet and occasionally even to 6 feet deep, reaching the surface from even the greatest depth. In places where the water has retreated, the seedlings sometimes grow so thick as to cover the mud with a sward, but their further development in an aerial environment is restrained.

Carum verticillatum, *Koch.* IV., V., VI. This is one of the characteristic plants of the lowland parts of Galloway in wet meadows, moors, and about the shores of lochs (fig. 27).

Cicuta virosa, *L.* V., VII. As a member of a loch flora, I have only observed this plant at Carlingwark Loch, where it is abundant, and at Otterston Loch (fig. 56).

Sium angustifolium, *L.* (=*S. erectum, Huds.*). [VI.—J. M'A.], VII. Always scarce.

Œnanthe crocata, *L.* "I.," IV., V., VI. In the lowland Areas this is a common plant on the marshy shores of lochs. It occurs in Area VII., but not at the lochs.

Angelica sylvestris, *L.* IV., VII. Occasionally on marshy shores.

RUBIACEÆ.

Galium palustre, *L.* "I.," IV., V., VI., VII. Frequent on the marshy shores of lochs (fig. 30).

VALERIANACEÆ.

Valeriana officinalis, *L.* IV., V., VI., VII. Sometimes found at the marshy shores of lowland lochs. In Area I. it is very rare at the lochs.

COMPOSITÆ.

Eupatorium cannabinum, *L.* "II.," VI. Only observed about the lochs of the Mochrum district (p. 139). [Often found in damp places by the seashore of Wigtownshire and Kirkcudbrightshire.—J. M'A.]

Gnaphalium uliginosum, *L.* VI., VII. Sometimes it forms a loose sward on damp sandy-muddy shores.

Bidens cernua, *L.* V., VI. Distribution restricted, and plants usually scarce (fig. 78).

Senecio aquaticus, *Hill.* "I., II.," IV., V., VI., VII. Frequent about the shores of lowland lakes, but scarce in Area VII.

Serratula tinctoria, *L.* IV. This southern plant is well established in dry bushy places about the west shores of Loch Ken.

Cnicus palustris, *Willd.* VII. In this Area it is frequently very abundant about marshy shores. In the other Areas, although a common plant, I have not seen it in any abundance on the shores of the lakes.

CAMPANULACEÆ.

Lobelia Dortmanna, *L.* "I., III.," IV., V., VI., VII. Frequently very abundant, but only in lochs that are more or less peaty. Rare in Area VII.

GENTIANACEÆ.

Menyanthes trifoliata, *L.* "I., II., III.," IV., V., VI., VII. This species is ubiquitous, and thrives under all kinds of environmental conditions.

BORAGINACEÆ.

Myosotis palustris, *With.*, including M. scorpioides, M. strigulosa, M. repens, and M. cæspitosa. "I., II., III.," IV., V., VI., VII. The characters distinguishing these are so interwoven that it is frequently almost impossible to decide definitely upon the specimen in hand. Although common, they are of but small importance as a constituent of a loch flora; I have therefore included the whole in the aggregate M. palustris. They occur chiefly about lowland non-peaty lakes.

Symphytum officinale, *L.* Seldom found upon the shores of lochs, but it does rarely so occur in Area VII.

SCROPHULARIACEÆ.

Scrophularia aquatica, *L.* "I.," IV., V. [VI.—J. M'A.]. Always scarce.

Scrophularia nodosa, *L.* IV. Abundant about the shores of Loch Ken and a few other places. A few plants occur sporadically about the lochs of Area I.

Mimulus Langsdorffii, *Donn.* V., VII. Well established on the muddy, marshy shores of several lakes.

Pedicularis palustris, *L.* "I., II., III.," IV., V., VI., VII. Common, and widely distributed.

Veronica scutellata, *L.* V., VI., VII. Seldom abundant.

Veronica Anagallis, *L.* "II.," V. Scarce.

Veronica Beccabunga, *L.* "I.," V., VI., VII. Sometimes very abundant in sheltered positions about the shallow margins of lowland lakes, and frequently overgrowing the shore.

LABIATÆ.

Mentha aquatica, *L.* IV., V., VI., VII. Often abundant on the marshy shores of lowland lochs. It also occurs in Areas I. and III., but sparsely.

Mentha sativa, *L.* "I., II., III.," IV., V., VI., VII. Abundant in lowland districts about marshy shores. The var. rubra, *Huds.*, also occurs, but less frequently.

Mentha arvensis, *L.* "I., III.," VI., VII. Sometimes on the dry, gravelly shores of lowland lakes this plant is represented by either the type or one of the varieties.

Scutellaria galericulata, *L.* "I.," V., VII. Scarce (*ante,* fig. 23).

Stachys palustris, *L.* IV., V., VII. Sporadic upon the shores of lowland lakes.

Lycopus europæus, *L.* V., VI., VII. Remarks appended to the last species apply to this also.

LENTIBULARIACEÆ.

Utricularia vulgaris, *L.* "I., II., III.," IV., V., VI., VII. Less abundant in the southern than in the northern Areas.

Utricularia intermedia, *Hayne.* "I.," IV., VI. This is also less abundant in the southern lochs. It occurs in pools in Area VII., but not in the lochs. I have never seen any Utricularia flowering in a loch; they appear to be continually reproduced by hybernacula.

PRIMULACEÆ.

Lysimachia nemorum, *L.* "I.," IV., V., VI., VII. Occasionally on the shores of lowland lakes, never abundant.

Lysimachia Nummularia, *L.* "I.," IV., V., VI., VII. Remarks appended to the last species apply to this also.

Lysimachia vulgaris, *L.* "I.," V., VI., VII. Restricted to a very few places regarding the lochs.

Anagallis tenella, *Murr.* V. On the shores of a very few lowland lochs, but seldom abundant (fig. 49).

PLANTAGINACEÆ.

Littorella lacustris, *L.* (=*L. uniflora, Aschers.*). "I., II., III.," IV., V., VI., VII. Abundant everywhere (*ante*, fig. 67).

Plantago lanceolata, *L.* Often conspicuous by its abundance on the stony shores of lochs in agricultural districts, especially in Area V.

POLYGONACEÆ.

Rumex Hydrolapathum, *Huds.* V. Scarce. The water-docks are very seldom seen at the lakes under consideration.

Polygonum amphibium, *L.* "I., II.," IV., V., VI., VII. Aquatic and terrestrial forms are frequently very abundant, but chiefly in lowland places (figs. 47, 84, 91, 101, etc.).

Polygonum Hydropiper, *L.* "I.," IV., V., VI., VII. Chiefly about lowland lochs; common, but seldom in abundance.

Polygonum Persicaria, *L.* VI., VII. Sometimes abundant on the shores of lowland lochs.

Polygonum aviculare, *L.* VI., VII. Sometimes this plant overgrows the drier parts of the shores of lowland lochs.

CERATOPHYLLACEÆ.

Ceratophyllum demersum, *L.* VII. Otterston Loch is the only record for the waters under consideration, and it grows there in such extraordinary abundance that in many places a boat can only be rowed through it with difficulty. Its presence doubtless excludes many plants that would otherwise thrive in that loch.

AMENTIFERÆ.

Alnus glutinosa, *Gært.* (=*A. rotundifolia, Mill.*). "I., II., III.," IV., V., VI., VII. Frequent.

Betula glutinosa, *Fries* (=*B. tomentosa, Reith and Abel*). "I., II. III.," IV., V., VI., VII. Frequent.

Myrica Gale, *L.* "I.," IV., V., VI. Frequent, sometimes 5 feet high in sheltered places (fig. 34).

Salix aurita, *L.* "I., II., III.," IV., V., VI., VII. Frequent.

The above four species are the most dominant trees or shrubs that occur naturally in wet places about the shores of lakes. Many other species and genera occur, especially about the lowland lakes, but mostly on drier ground. These and the damp-loving species of Salix, Populus, etc., that are found, generally bear evidence of having been planted for ornamental or other purposes.

HYDROCHARIDACEÆ.

Anacharis Alsinastrum, *Bab.* (=*Elodea canadensis, Michx.*). VII. Particularly abundant in Loch Leven, but less so than formerly on account of the raids made against it by the angling authorities [VI. Monreith Loch.—J. M'A.].

IRIDACEÆ.

Iris Pseud-acorus, *L.* "I., II., III.," V., VI., VII. Frequent, often overgrowing a considerable patch of littoral marsh, but rarely seen at the hill lochs (figs. 97 and 102).

ALISMACEÆ.

Alisma Plantago, *L.* (=*A. Plantago-aquatica, L.*). "I., II.," V., VI., VII. Abundant in many places. A curious submersed form occurs at Loch Gelly (p. 161).

Alisma ranunculoides, *L.* "III.," IV., V., VI., VII. Widely distributed, but seldom abundant. Dwarf forms about 1½ inches high occur on the exposed sandy shores of Loch Leven and other places. An entirely submersed form about 3 inches high, with quite subulate leaves, is occasionally found, and is abundant at Loch Corsock. There it flowers under water to a depth of 3 feet; without the flower-stalk these submersed forms look extremely like Isoetes lacustris.

JUNCAGINACEÆ.

Triglochin palustre, *L.* "I., II.," IV., VI. Scarce, and sporadically scattered about the shores of lochs.

MELANTHACEÆ.

Narthecium ossifragum, *Huds.* "I.," IV., V., VI. On peaty shores, but seldom abundant.

JUNCACEÆ.

Juncus effusus, *L.* "I., II., III.," IV., V., VI., VII. Abundant everywhere, and often covering large areas of ground (figs. 66, 75, 79, etc.).

Juncus conglomeratus, *L.* "I., III.," IV., V., VI., VII. On dryer ground than J. effusus, and very much less abundant.

Juncus glaucus, *Ehrh.* (=*J. inflexus, L.*). VII. Not uncommon in some of the other Areas, but I have only observed it on the shores of lochs in Area VII.

Juncus bufonius, *L.* "I.," IV., VI., VII. Frequent about the shores of many lowland lochs, but less common at the hills. Its var. fasciculatus, *Bert.*, is sometimes found growing in dense prostrate tufts on exposed sandy shores.

Juncus lamprocarpus, *Ehrh.* (=*J. articulatus, L.*). I., II., III.," IV., V., VI., VII. Abundant on the shores of lochs, especially where the water is more or less peaty.

Juncus acutiflorus, *Ehrh.* (=*J. sylvaticus, Reichb.*). "I., II., III.," IV., V., VI., VII. Abundant on the shores of lochs, but it is perhaps more plentiful about the non-peaty lowland lochs than J. lamprocarpus.

When, as sometimes happens, it could not be readily determined to which of the last two species a specimen was referable, I have called the plant J. articulatus, with the old aggregate meaning. They both vary greatly, but I think most of the reduced forms so frequently met with are from the acutiflorus group (figs. 18, 51. etc.).

Juncus supinus, *Moench* (=*J. bulbosus, L.*) "I.," IV., V., VI., VII. A more protean species than the last mentioned. In a former contribution (*ante*, p. 976), I gave some descriptive matter regarding the forms of this plant; all of these variations occur also in the Areas now under consideration. In the districts now being discussed, the terrestrial forms are more abundant than in the Ness Area, whilst the aquatic form var. fluitans (*Juncus fluitans, Lam.*) is less abundant than in the Ness Area. The last-mentioned form, however, is plentiful in many of the peaty lochs of Areas IV. and VI., but in V. and VII. it is scarce.

TYPHACEÆ.

Typha latifolia, *L.* "III.," V., VI., VII. Chiefly on the shores of lowland lochs, but not common, nor is it often abundant (figs. 73 and 74). The only place at which I have ever seen this plant in a peaty lochan on an exposed peat moor is at L. Wayoch, Drumdow Moss, Wigtownshire. The appearance of this and other plants such as Eupatorium cannabinum, in the midst of so peaty an area as the Mochrum district, seems to indicate the presence of some agent (*e.g.* calcium or potassium) counteracting the influence of the humic acids from the peat, and derived from the disintegration of the underlying rock.

Typha angustifolia, *L.* V., VII. Of more restricted distribution than the last, but where it does occur it is usually in greater abundance and covers a considerable area of ground (figs. 84 and 85).

Sparganium ramosum, *Huds.* (=*S. erectum, L.*). "I., II., III.," V., VI., VII. More abundant in Area VII. than elsewhere, chiefly on the rich boggy margins of lowland lochs. Dwarf varieties occur as well as the large normal form.

Sparganium simplex, *Huds.* V., VII. In similar situations to the last species, but usually much less abundant. Weak forms with elongated floating leaves also occur, usually in a foot or so of water. The var. longissimum, *Fries*, occurs sparingly at Loch Fitty.

Sparganium natans, *L.* (=*S. affine, Schnizl.*). "I.," IV., V., VI., VII. Rather frequent in IV., scarce elsewhere. Chiefly in peaty lochs of moderate elevation (*ante*, fig. 34).

Sparganium minimum, *Fries.* "I.," IV., VI. Generally scarce, and mostly confined to the hill lochs. I have previously remarked (*ante*, p. 977) upon the variable nature of this genus. It seems to me that the most degenerate form of S. minimum and the most robust condition of S. ramosum are connected by numerous intermediates. Perhaps experimental culture on the right lines with S. ramosum would produce all the other forms.

LEMNACEÆ.

Lemna trisulca, *L.* VII. Rarely found in the lochs, and only in those having a luxuriant marginal vegetation and non-peaty water, well sheltered by trees. It is very abundant in Kilconquhar Loch.

Lemna minor, *L.* VII. Remarks same as to the preceding species, but more frequently met with in the lochs. It is a common plant in ditches, etc., in all the Areas below about 500 feet elevation.

POTAMOGETONACEÆ.

Zannichellia palustris, *L.*, var. brachystemon (*Gay*). VII. Rare in the lochs as a rule, but extremely abundant in Kilconquhar Loch.

Potamogeton natans, *L.* "I., II., III.," IV., V., VI., VII. Abundant everywhere. It seems to me that this plant and its congener P. polygonifolius run into one another somewhat, although the two species can usually be easily distinguished by the characters exhibited by leaf, fruit, etc. The typical P. natans is most often found in non-peaty lowland areas. The typical P. polygonifolius is frequently met with in peaty areas, and often in mountainous districts, whilst the two are sometimes seen growing together in all kinds of situations.

Potamogeton polygonifolius, *Pourr.* "I.," IV., V., VI., VII. The typical form is certainly less abundant in non-peaty lochs than the form approaching P. natans in size and texture of leaf, etc.

Potamogeton polygonifolius, *Pourr.*, var. pseudo-fluitans, *Syme.* IV. Abundant in Loch Recar and others in the same district, as well as in the streams. None fertile (*i.e.* in September). A very distinct variety with elongated, rather pellucid leaves that are beautifully netted near the midrib.

Potamogeton rufescens, *Schrad.* (=*P. alpinus, Balb.*). V., VI., VII. Sometimes abundant, but not a very common species. The variety spathulifolius, *Fischer*, occurs in Black Loch (p. 168).

Potamogeton heterophyllus, *Schreb.* "III.," V., VII. In lowland lakes, but not a very common plant in these Areas. The var. terrestris, *Schlecht.*, occurs at Loch Leven.

Potamogeton lucens, *L.* "I., II.," IV., V., VI., VII. Frequently abundant, and variable in form. The very large forms usually occur in non-peaty lochs.

Potamogeton Zizii, *Koch* (=*P. angustifolius, Bercht. and Presl.*). IV., VI., VII. Sometimes very abundant, especially in Area VII.

Potamogeton crispus, *L.* "I.," V., VI., VII. Not a very common species, nor often in abundance, excepting in Area VII. At White Loch, Castle-Kennedy, and in other lochs near it, a beautiful form occurs, having wide, bright red midribs to the leaves. The var. serratus (*Huds.*), which has greener, flatter leaves than the type, sometimes occurs.

Potamogeton perfoliatus, *L.* "I., II.," IV., V., VI., VII. Frequent, and sometimes abundant.

Potamogeton prælongus, *Wulf.* "I.," IV., V., VI., VII. A deep-water species (6–20 feet). Rather frequent, but seldom very abundant.

Potamogeton Friesii, *Rupr.* V. Only in Carlingwark Loch, where it is very plentiful.

Potamogeton pusillus, *L.* "I., II.," IV., V., VI., VII. Frequent. The narrow-leaved form — var. tenuissimus, *Mert.* and *Koch* — occurs occasionally in rather deeper water than the type.

Potamogeton obtusifolius, *Mert.* and *Koch.* II., V., VI., VII. Sometimes abundant. At Barlockhart Loch a dwarf bushy form 6–8 inches long occurred in the shallow water, normal forms being abundant in the deeper water. The var. fluvialis, *Lange* and *Mort.*, occurs in deep water at Burntisland Reservoir, Lismore, etc.

Potamogeton filiformis, *Pers.* (= *P. marinus, L.* ?). "II.," VII. Frequently abundant, particularly so at Loch Fitty, where in some places the ripe fruits of this plant, with those of P. pusillus and P. pectinatus, washed up on the shore, formed a considerable stratum. The var. alpina, *Blytt*, is plentiful in Loch Gelly.

Potamogeton flabellatus, *Bab.* (= *P. interruptus, Kit.*). VII. Very abundant in Town Loch, Dunfermline.

Potamogeton pectinatus, *L.* VII. Scarce, but plentiful in Lochs Gelly, Fitty, Kilconquhar, etc. [VI. Rare. Ravenstone Loch, near Sorbie.—J. M'A.] It is abundant in Duddingston Loch, near Edinburgh.

Mr A. Bennett kindly examined a number of difficult forms of Potamogeton for me.

CYPERACEÆ.

Schœnus nigricans, *L.* VI. About the peaty shores of lochs, not common, nor often abundant. [Frequent in damp places along the seashore of Wigtownshire.—J. M'A.]

Cladium Mariscus, *Br.* VI. Very abundant about lochs in the Mochrum district. On Anabaglish Moss several small lochans are entirely surrounded by it (figs. 62–64).

Rhynchospora alba, *Vahl.* IV., VI. Sometimes abundant on shores of boggy peat; a very common moorland plant in these Areas.

Heleocharis palustris, *Br.* "I., II., III.," IV., V., VI., VII. Ubiquitous and variable; sometimes it grows 3 feet high, as at White Loch, Castle-Kennedy, at other places less sheltered from wind it only grows a few inches high. One such dwarf form, with short, stout, very scaly rhizomes, and few flowering stems, which were about 4 inches high, was overgrowing an exposed sandy shore at Loch Grennoch. H. uniglumis, *Schultes*, occurs at the Isle of May in pools (figs. 98, 121, etc.).

Heleocharis multicaulis, *Sm.* IV., V., VI. Sometimes abundant in the more or less peaty lochs, where the leaves often float on the surface, and are occasionally viviparous at the extremities (fig. 68).

Heleocharis acicularis, *Br.* IV., VI., VII. Not a common plant, but occasionally abundant. It forms a sward on the wet sandy or muddy shores of lochs, and enters the water to a depth of about a foot;

sometimes, however, to a depth of 3 or 4 feet, in which case the plants are much elongated and flowerless.

Scirpus fluitans, *L.* IV., VI. Common in the peaty lochs of these Areas, and sometimes very abundant (fig. 25).

Scirpus setaceus, *L.* VII. On sandy shores, scarce.

Scirpus lacustris, *L.* "I., II., III.," IV., V., VI., VII. Widely distributed and abundant in both peaty and non-peaty lochs (figs. 23, 32, 33, 89, etc.).

Eriophorum vaginatum, *L.* "I.," IV., VI., VII. Sometimes found upon the peaty shores of hill lochs.

Eriophorum polystachion, *L.* (=*E. angustifolium, Roth.*). "I., II.," IV., V., VI., VII. More frequent than the last mentioned, especially upon the more or less peaty shores of lowland lochs; less abundant amongst the mountains.

Carex canescens, *L.* VII. Rare at the lochs.

Carex disticha, *Huds.* VII. On sandy-muddy shores, scarce at the lochs. [In meadows at the head of Loch Ken and near Carlingwark Loch.—J. M'A.]

Carex paniculata, *L.* VII. Forms large tussocks, and occupies a considerable area of deep bog at the west end of Otterston Loch (fig. 103). [VI. Dowalton Loch.—J. M'A.]

Carex aquatilis, *Wahl.* "I., II.," IV., VII. Both the small and the large lowland forms (elatior, *Bab.*) are sometimes very abundant; at the head of Loch Ken specimens over 6 feet high were observed. The appearance of this plant in Fife has been queried. It was first recorded there by Professor J. H. Balfour at Loch Fitty in 1862. There it still exists in abundance, especially at the west end of the loch, where it grows 3 feet high in the water and 1 foot high on the boggy shore. It has also spread to Burntisland Reservoir, but is likely to be destroyed there when the proposed alterations are carried out (fig. 104).

Carex Goodenovii, *Gay.* "I., II.," IV., V., VI., VII. Widely distributed and often very abundant about the shores of both lowland and subalpine lochs; on drier parts of the shores of the latter, very dwarf forms are frequent. By accidentally overlooking a sheet of notes, this plant was omitted from Areas I. and II. (*Proc. Roy. Soc. Edin.*, vol. xxv., pt. xi.). It is very plentiful, particularly in Area I.

Carex flava, *L.* "I., III.," IV., V., VI., VII. The type and its varieties are frequent upon the shores of lochs, but seldom in abundance.

Carex flacca, *Schreb.* "II.," IV., VII. Not uncommon, thriving chiefly about lowland lochs, and occasionally abundant, as at Burntisland Reservoir, where it overgrows areas of marshy ground; at the same loch stragglers may also be found in drier situations, even on the adjacent roadside. The specimens from the last-mentioned site are much dwarfed, and resemble the var. stictocarpa, *Druce.*

Carex flacca, *Schreb.*, var. stictocarpa, *Druce.* "III.," IV., V., VI., VII. Scattered specimens are frequent, but it seldom occurs in abundance.

Carex binervis, *Sm.* "I.," IV., VI. On boggy, peaty shores usually scarce.

Carex filiformis, *L.* (= *C. lasiocarpa, Ehrh.*). "I.," IV., V., VI. Frequent and abundant at the margins of alpine and sub-alpine lochs, where it is sometimes the only dominant species of this genus (fig. 19).

Carex hirta, *L.* VII. Not general about lochs, but it grows in abundance on the exposed sandy shores of Loch Leven, where, in common with several other plants, it assumes a dwarf habit, growing only from 4 to 8 inches out of the sand. It grows there much after the manner of Carex arenaria on the sandy seashore, and, like it, binds the sand with its long scaly rhizomes.

Carex rostrata, *Stokes* (= *C. inflata, Huds.*). "I., II., III.," IV., V., VI., VII. Probably the most abundant and dominant plant of all. It grows at the margins of both peaty and non-peaty lochs of any elevation, from the shore out into water 1 or 2 feet deep (figs. 22, 48, 96, etc.).

Carex vesicaria, *L.* "I.," IV. Occasionally very abundant; at the head of L. Ken, for example, there are large associations of it. Frequently the beak of the nut is curiously looped within the perigynium; this results from the long style not being allowed to pass out of the mouth of the perigynium as the nut develops.

Carex acutiformis, *Ehrh.* V. As a constituent of a loch flora I have only observed this plant at Carlingwark Loch.

GRAMINEÆ.

Phalaris arundinacea, *L.* "I.," IV., V., VI., VII. Rather common at loch margins, but principally about lowland lochs (fig. 71).

Phragmites communis, *Trin.* "I., II., III.," IV., V., VI., VII. A very dominant and abundant species in lowland or highland, peaty or non-peaty lochs. On the rich muddy shores of wind-sheltered lochs it attains great luxuriance, often being 8 or 10 feet high in such situations, and overgrowing large areas (figs. 44, 65, 90, 95, and p. 168).

Deschampsia cæspitosa, *Beauv.* "I.," IV., V., VI., VII. A very usual member of the shore flora of lochs, but generally in small quantities.

Glyceria fluitans, *Br.* "I., II., III.," IV., V., VI., VII. Widely distributed, but seldom occurring in great abundance (*ante,* fig. 95).

Glyceria aquatica, *Wahlb.* V., VII. Seldom seen at the lochs, but occasionally it occurs in great abundance: instance Carlingwark Loch, Lindores Loch, and others (figs. 54, 83, etc.).

Alopecurus geniculatus, *L.*, is very abundant on the sandy-muddy shore of Town Loch, Dunfermline.

Agrostis vulgaris, *With.*, is very abundant at the same place as the last mentioned, and also at Lindores Loch. Small patches or isolated specimens of these two grasses, with other terrestrial species, are frequently found mixed with the semi-aquatic vegetation of the littoral. Frequently, too, the grass sward of a moor or meadow adjoining a loch enters the water, and, contrariwise, aquatics such as Littorella lacustris leave the water, and compete for *terra firma* against the land plants. Aquatic and terrestrial zones of vegetation in such cases are undeterminable.

EQUISETACEÆ.

Equisetum limosum, *L.* "I., II., III.," IV., V., VI., VII. This is another very abundant plant; large associations occur at the margins of lochs of all descriptions. The var. fluviatile (*L.*) is sometimes found.

Equisetum arvense, *L.* Occasionally found overgrowing sandy or stony shores, in which case, unless sheltered by other vegetation, it is always prostrate and dwarfed.

Equisetum palustre, *L.* Occasionally found amongst the marsh vegetation of lowland lochs, and sometimes on sandy-muddy shores. In the last habitat it is always dwarfed and frequently prostrate. Sometimes this and the preceding plant grow together in a dwarfed and semi-prostrate condition as at Loch Leven, in which case the two species are difficult to distinguish from one another. These two species of Equisetum usually occur so sparsely as to be scarcely worth mentioning as constituents of a loch flora.

MARSILEACEÆ.

Pilularia globulifera, *L.* VI. Rare, but occasionally very abundant, at Loch Dernaglar for example (fig. 69).

LYCOPODIACEÆ.

Isoetes lacustris, *L.* "I.," IV., V., VI. Very general in peaty lochs, but neither so abundant nor so variable in form as in Area I.

CHARACEÆ.

Messrs H. and J. Groves kindly named a number of difficult forms. On the whole, these plants are less abundant in Areas IV., V., and VI. than in the three former Areas, but they are very abundant in Area VII.

Nitella opaca, *Ag.* "I.," IV., V., VI., VII. Generally distributed in peaty lochs. I have never dredged it from a greater depth than about 16 feet in the present Areas, nor, indeed, have I found any of the more highly organised plants at a much greater depth in Areas IV.–VII. Reasons for this will be given on subsequent pages.

Nitella translucens, *Ag.* "I.," VI. Only observed in the Mochrum district. A very large form in a barren state extremely like N. translucens was referred by Messrs Groves to N. flexilis or N. opaca. It was abundant in Loch Ken and Woodhall Loch at depths of from 6 to 8 feet.

Tolypella glomerata, *Leonh.* VII. In Loch Leven, but apparently very scarce.

Chara aspera, *Willd.* "II., III.," V., VII. Sometimes slightly incrusted with lime, and frequently abundant in lowland non-peaty lochs, or in lochs that receive the drainage of villages. This plant sometimes grows in prodigious quantity, as in Loch Leven, where hundreds of acres of the bottom are covered by it. In that loch it occurs at depths of from 1 to 15 feet, but is most abundant at 4 to 8 feet deep. Some of the varieties of this species are also common, and frequently grow with the type, vars. subinermis, *Kuetz.*, and desmacantha, *H.* and *J. G.*, being the most usual, but var. capillata, *Braun.*, is abundant in Area VII.

Chara fragilis, *Desv.* "I., II.," IV., V., VI., VII. This species thrives in both peaty and non-peaty waters. In the former case it is usually free of lime, in the latter it is frequently more or less incrusted with that substance. The common form in peaty lochs is the var. delicatula, *Braun.* Both forms are occasionally very abundant. The var. fulcrata, *Gant.*, occurs in Area VII.

Chara vulgaris, *L.* VII. This does not appear to be a common plant in the lochs, but it occurs in Loch Leven as well as in some other lochs of Area VII. where the var. papillata, *Wallr.*, also grows.

Chara hispida, *L.*, var. rudis, *Braun.* "II," VII. Very plentiful in Lochmill Loch, where it is only slightly incrusted with lime.

Chara contraria, *Braun.* IV., VII. Scarce in the first Area, but more abundant in VII. Regarding a dwarf slightly incrusted form from shallow water in Loch Whinyeon, Messrs Groves write:—"A very interesting little plant intermediate between C. contraria and C. vulgaris, but we think it best placed under the former." The var. hispidula, *Braun.*, occurs in Area VII.

The Bryophyta often form a conspicuous portion of the shore flora of the lochs in Areas IV. and VI., very much more so than in any of the other districts. By instituting a careful search for these plants, a very long list might be arranged, particularly in Area IV., which is veritably a bryologist's paradise.

SPHAGNACEÆ.

Sphagnum intermedium, *Hoffm.* IV., VI., VII. On boggy shores of peaty lochs.

Sphagnum cymbifolium, *Ehrh.* "I.," IV., VI., VII. On boggy shores of peaty lochs.

Sphagnum acutifolium, *Ehrh.* "I.," IV., V., VI., VII. Universal in one or other of its numerous forms on the boggy shores of peaty lochs.

Sphagnum cuspidatum, *Ehrh.* "I.," IV., VI. Frequent in the water in bays, etc. of small peaty lochs, as well as on their boggy shores. The variety plumosum, *Nees.* and *Hornsch.*, is less frequent.

Sphagnum subsecundum, *Nees.* "I." IV., VI. In similar habitats to the last, but less frequent. Sometimes it occurs in rather deep water: instance, Loch Grennoch, where it grows from 2 to 8 feet deep, mixed with Littorella, etc. (p. 113).

POLYTRICHACEÆ.

Polytrichum commune, *L.* This common moorland moss is occasionally very plentiful on peaty shores in all districts.

Catharinea undulata, *Web.* and *Mohr.* IV. A common moss, but it rarely occurs in abundance at the lochs, as it is more or less a terrestrial plant. At Loch Minnoch, however, submersed rocks were abundantly clothed with an aquatic form of it (p. 126).

DICRANACEÆ.

Dichodontium pellucidum, *Schp.* IV., VI. Common on rocky shores of lochs in hilly districts.

Blindia acuta, *B.* and *S.* "I.," IV., V., VII. On wet or submersed rocks; common about the shores of hill lochs.

Dicranella squarrosa, *Schp.* IV. Often abundant on the wet boggy shores of hill lochs. D. heteromalla, *Schp.*, is also frequent, but on drier ground.

Dicranum fuscescens, *Turn.* IV. Common on rocks of the shores of hill lochs.

Dicranum Scottianum, *Turn.* IV. Habitat as above, but less common.

FISSIDENTACEÆ.

Fissidens adiantoides, *Hedw.* "I.," IV. Often abundant in wet places on rocky shores.

GRIMMIACEÆ.

Grimmia apocarpa, *Hedw.* IV., VI. Common on the dry parts of littoral rocks.

Grimmia apocarpa, *Hedw.*, var. rivularis, *Web.* and *Mohr.* IV., VI. Frequently abundant on wet and submersed rocks, occasionally down to 5 or 6 feet deep. In the other Areas it is scarce at the lochs.

Rhacomitrium lanuginosum, *Brid.* IV. Often a conspicuous object upon rocks of the shores.

Rhacomitrium heterostichum, *Brid.* IV. Various forms of it are common in similar situations to the last.

Rhacomitrium aciculare, *Brid.* "I.," IV., V., VII. Frequent upon wet and submersed rocks, but sometimes only near the embouchure of a burn.

Rhacomitrium protensum, *Braun.* IV. Sometimes abundant on wet rocks. When luxuriant, as at Loch Dungeon, it has a very pleasing appearance.

Hedwigia ciliata, *Ehrh.* IV. The type and the var. leucophæa, *B.* and *S.*, frequently cover the syenite rocks that abound upon the shores, or crop out of the water as little islands.

TORTULACEÆ.

Trichostomum tortuosum, *Dixon.* IV. Occasionally abundant on the littoral rocks of hill lochs.

ORTHOTRICHACEÆ.

Orthotrichum rupestre, *Schleich.* IV., VI. A common moss on rocks about the shores of lochs in hilly districts.

MEESIACEÆ.

Aulacomnium palustre, *Schwæg.* In wet places about shores, or even in the water; frequent in all the Areas.

BARTRAMIACEÆ.

Philonotis fontana, *Brid.* "I.," IV., VII. On wet shores or at the margin of the water; common in IV., and occurring in all the other Areas sparingly. P. calcarea, *Schp.*, occurs on the boggy shore at the S.E. end of L. Leven, where there are probably seams of lime.

Breutelia arcuata, *Schp.* IV. On rocks, generally scarce at the loch shores, but it grows in magnificent luxuriance at Loch Dungeon.

BRYACEÆ.

Several species of Bryum occur, but seldom in abundance. B. alpinum, *Huds.*, is sometimes noticeable on rocks of the hill lochs in Area IV. B. bimum, *Schreb.*, occurs in scattered patches on wet or boggy shores here and there in all the Areas; similarly does B. pallens, *Swartz.* At Burntisland Reservoir in July, a curious form of the last mentioned was very abundant on the clayey bottom in water to a depth of about 18 inches. Returning in October for more of it for Mr H. N. Dixon, not a trace could be found, owing to the water level of the reservoir having fallen greatly through drought. Respecting this plant Mr Dixon wrote as follows:—"Mr Nicholson, to whom I sent the Burntisland Reservoir Bryum, agrees with me that while, at first sight, it resembles B. neodamense, *Itzigs.*, it is really an altered form of Bryum pallens, *Swartz.*"

Mnium punctatum, *L.* IV. Frequently abundant on wet, somewhat sandy shores and in bogs; also in the other Areas, but not plentiful at the lochs.

FONTINALACEÆ.

Fontinalis antipyretica, *L.* "I., II.," IV., V., VI., VII. Abundant in many places. I have not dredged it from a greater depth than 10 feet in any of the four last Areas. In V. and VII. it is less common than elsewhere.

Fontinalis squamosa, *L.* IV., VI. Sometimes plentiful, but not a common moss in the lochs.

HOOKERIACEÆ.

Pterygophyllum lucens, *Brid.* IV. Abundant about the wet shores of the hill lochs, mostly on the soil.

LEUCODONTACEÆ.

Pterogonium gracile, *Swartz.* IV. On shore rocks, frequent and abundant at lochs amongst the hills.

LESKEACEÆ.

Heterocladium heteropterum, *B.* and *S.* IV. This delicate species is seldom found at the lochs. It was, however, very abundant as a submersed aquatic at Loch Grennoch, even to a depth of 10 feet. Mr H. N. Dixon, to whom specimens were submitted, replied as follows:—"It is certainly Heterocladium heteropterum, *B.* and *S.*, and it is a remarkable situation for that moss, which is by no means an aquatic species, though accustomed to wet and even dripping rocks and moist earth."

HYPNACEÆ.

Climacium dendroides, *Web.* and *Mohr.* V., VII. Occasionally abundant on boggy shores.

Hyocomium flagellare, *B.* and *S.* IV. Frequent on shore rocks.

Brachythecium rivulare, *B.* and *S.* "I.," IV., VI., VII. On dry and submersed rocks, frequent.

Eurhynchium rusciforme, *Milde.* "I.," IV., and in all the other Areas, but scarce at the lochs. At the south end of Loch Doon it was very abundant at depths of from 3 to 5 feet, occurring there with Fontinalis antipyretica.

Hypnum riparium, *L.* VII. Not common at lochs, but it is abundant on stones at Burntisland Reservoir.

Hypnum stellatum, *Schreb.* IV., V., VI., VII. Often abundant on boggy shores.

Hypnum fluitans, *L.* "I.," IV., VI., VII. Forms of this plant are common about the hill lochs.

Hypnum uncinatum, *Hedw.* "I.," IV. On rocks of the shores of hill lochs.

Hypnum revolvens, *Swartz.* IV., VII. On wet shores, chiefly of the hill lochs.

Hypnum commutatum, *Hedw.* IV., VII. Remarks same as to the last.

Hypnum falcatum, *Brid.* "I.," IV., VII. Remarks same as to the two preceding species.

Hypnum vernicosum, *Lindb.* IV. Common at L. Minnoch.

Hypnum cupressiforme, *L.* IV. Forms of this common moss frequently cover rocks on the shores in this Area. In the other Areas it is much less abundant at the lochs.

Hypnum scorpioides, *L.* "I., II.," IV., VI., VII. Common on wet shores; less frequent in Area VII. Only the ordinary forms were noticed (*ante*, p. 983).

Hypnum stramineum, *Dicks.* "I.," VII. Only observed in abundance at Loch Fitty [IV., V.—J. M'A.].

Hypnum cuspidatum, *L.* "I.," IV., V., VI., VII. Common in marshy places about lochs, sometimes in great abundance, and frequently growing in the water.

Hylocomium squarrosum, *B.* and *S.* I., II., III., IV., V., VI., VII. A common and often abundant moss on boggy or wet shores, chiefly in lowland districts, particularly in Areas IV. and VI.

JUBULEÆ.

Frullania tamarisci, *Dum.* IV. Frequently covering damp rocks by the shores of the higher lochs.

PORELLEÆ.

Pleurozia cochleariformis, *Dum.* IV. Occasionally conspicuous on boggy shores of the higher lochs.

PTILIDEÆ.

Anthelia julacea, *Dum.* IV. Occasionally its gray-green, tufted patches form a noticeable object on the wet sandy or peaty shores of the mountain lochs.

SCAPANIOIDEÆ.

Scapania undulata, *Dum.* "I.," IV., VI. Abundant on rocks and stones at the margins of hill lochs, either submersed or out of the water. VII. On the shores of the hill lochs, scarce.

Diplophyllum albicans, *Dum.* IV. Sometimes covering the rocks of the shores of the hill lochs.

EPIGONIANTHEÆ.

Chiloscyphus polyanthos, *Dum.* V. Occasionally abundant on wet shores.

Mylia Taylori, *Gr.* and *Benn.* IV. Large patches of this hepatic occasionally occur on wet rocks or wet sandy shores of the hill lochs.

Nardia compressa, *Gr.* and *Benn.* "I.," IV. Abundant on wet and submersed rocks, chiefly at the higher lochs. Sometimes a considerable area of submersed rocks and stones to a depth of 3 feet is covered with a dense carpet of this hepatic: instance Lochs Enoch, Dungeon, etc.

Nardia emarginata, *Gr.* and *Benn.* (=*Marsupella emarginata*, *Dum.*). "I.," IV. On wet rocks and shores of hill lochs, and often in the water; rather less abundant than the last mentioned.

Nardia scalaris, *Gr.* and *Benn.* IV. On wet sandy-peaty shores of hill lochs, often abundant.

The following species are frequently found covering wet places about lochs, particularly on shady banks, under rocks, etc., in all the Areas, but especially in IV.:—Pellia calycina (*Tayl.*), P. epiphylla, *Lindb.*, Conocephalus conicus, *Dum.*, and Marchantia polymorpha, *L.* The last mentioned is often found in the water of bogs as well as in drier places.

Several species of Jungermannia are met with on the shores of the more elevated lochs, but always in small quantities.

Amongst the mountains of Area IV. many lochs are bordered more or less by rocks which are frequently covered in a most prolific manner with masses of lichens. A description of the flora of these lochs would be incomplete were it not, under such circumstances, to notice the most predominant and conspicuous species of these lichens. They are as follows:—Platysma glaucum, *Nyl.*, Cetraria aculeata, *Fr.*, C. muricata, *Ach.*, Parmelia lanata, *Wallr.*, P. omphalodes, *L.*, Alectoria jubata, *Nyl.*, Lecanora tartarea, *Ach.*, Sphærophoron coralloides, *Pers.*, Lecidea geographica, *Schær.* (p. 101).

ALGÆ.

A few very abundant species that were noticed:—

Batrachospermum moniliforme, *Roth.* "I.," IV. Abundant; very scarce in the other Areas.

Batrachospermum vagum, *Roth.* I. Scarce. IV., VI. Frequent; very scarce in the other Areas.

Enteromorpha intestinalis, *Link.* "III.," V., VII. Particularly plentiful in Kilconquhar Loch and Loch Fitty.

Ulothrix æqualis, *Kütz.*, and its var. catæniformis, *Rabenh.* In all the Areas, but particularly in IV.

Cladophora fracta, *Kütz.* "II.," VII. Occasionally very abundant.

Cladophora crispata, *Roth.* VII. Occasionally abundant.

Cladophora flavescens, *Ag.* V., VII. Sometimes very abundant in lochs that receive the drainage of villages.

Cladophora canalicularis, *Roth.* VI., VII. Abundant; less so in the other Areas. It covers stones and rocks about the shores of lochs that receive the drainage of villages, farms, and cultivated land. It is often covered with a prodigious quantity of diatoms, chiefly of the genera Cocconeis, Gomphonema, Diatoma, etc. A handful of this Cladophora was taken from Loch Fitty and floated at the top of a tall vessel of water. In the course of several days a considerable deposit of pure diatom frustules had fallen from the Cladophora and collected upon the bottom of the vessel.

Cladophora glomerata, *Kütz.* Very abundant in some lochs of Areas IV. and VI., covering stones and rocks from the margin to 7 feet deep.

Mougeotia sp. Sometimes very abundant in I. and IV.

Zygogonium ericetorum, *De Bary.* "I.," IV. Often very abundant in water near the shores of the hill lochs.

Zygnema Vaucherii, *Ag.* "I., II." It is also very frequent in lochs of Areas IV. and VI.

Porphyridium cruentum, *Näg.* VI. Wet mud at Barhapple Loch, exposed through drought, was in places coloured red by this organism.

Glœotrichia Pisum, *Thur.* VI. Occurred in such extreme abundance as a plankton organism in Soulseat L. that the water in some of the little creeks was of the consistency of liquid mud.

Anabæna circinalis, *Rabenh.* VII. The water of Kinghorn Loch in places had the appearance of pale green paint, due to the vast quantity of this organism. It is frequently common in lowland lochs. The relationship between the presence of this plant and the death of certain fish, particularly perch, requires further elucidation. I found numbers of dead perch around Kinghorn Loch.

Melosira granulata, *Ralfs.* VI. Occurs as a plankton organism in White Loch, Castle-Kennedy, in such abundance that the discoloration of the water (p. 143) is in part due to it.

Dickieia and similar gelatinous Diatomaceæ. "I.," IV. Sometimes abundant at the margins of the hill lochs. Other diatoms, of course, abound everywhere.

I have frequently found submersed plants of the higher orders injured by the luxuriant growth of filamentous Algæ. In Lochs Skerrow and Grennoch, for example, quantities of Scapania undulata were in a defunct condition through being overgrown with Ulothrix æqualis, Batrachospermum vagum, Binuclearia tatrana, etc.

The following comparative table has been arranged in order to show at a glance the most conspicuous and abundant plants (*i.e.* those forming more or less definite associations) of peaty and non-peaty lochs, together with the positions they usually occupy therein. The plants have been divided into seven groups, and those in each group are so arranged that the species inhabiting the driest ground or the shallowest water are placed first, and those occupying the deepest water last,—the whole table being kept as nearly as possible in the same order. The figures following the species indicate in feet the average depths at which they occur, a medium between the two extremes being the most usual habitat.

COMPARATIVE TABLE.

PEATY MOORLAND LOCHS WITH CLEAR WATER.	NON-PEATY LOWLAND LOCHS WITH CLEAR WATER.
1. *The Drier Marsh Species.*	
Bryophytes on shore rocks often abundant.	Bryophytes on shore rocks usually scarce.
Deschampsia cæspitosa.	Gnaphalium uliginosum.
Juncus effusus.	Deschampsia cæspitosa.
Juncus bufonius.	Carex hirta.
Mentha sativa.	Juncus conglomeratus.
Eriophorum polystachion.	Spiræa Ulmaria.
Eriophorum vaginatum.	Juncus effusus.
Phalaris arundinacea.	Juncus bufonious.
Juncus supinus.	Mentha sativa.
Ranunculus Flammula.	Phalaris arundinacea.
	Carex disticha.
	Ranunculus Flammula.
2. *Marsh Species with their Bases usually in Semi-Liquid Mud, or even in Water.*	
Various bog mosses, including species of Sphagnum and Polytrichum.	Various bog mosses, excluding species of Sphagnum and Polytrichum.
Caltha palustris.	Caltha palustris.
Carex Goodenovii.	Carex Goodenovii.
Carex vesicaria.	Mentha aquatica.
Carex aquatilis (dwarf form).	Iris Pseud-acorus.
Juncus acutiflorus, shore–1.	Ranunculus Lingua.
Juncus lamprocarpus, shore–1.	Alisma Plantago.
Comarum palustre, shore–1.	Sparganium ramosum, shore–1.
Hypericum elodes, shore–1.	Juncus acutiflorus, shore–1.
	Juncus lamprocarpus, shore–1.
	Carex paniculata, shore–1.
	Typha latifolia, shore–1.
	Glyceria aquatica, shore–1.
	Comarum palustre, shore–1.
	Sparganium simplex, shore–1.
	Epilobium hirsutum, shore–1.

PEATY MOORLAND LOCHS—*contd.* | NON-PEATY LOWLAND LOCHS—*contd.*

3. *Semi-Aquatic Species that send up from the Water a strong Aerial Flowering Stem, but without special Submersed or Floating Leaves.*

Menyanthes trifoliata, shore–1.
Heleocharis palustris, shore–1½.
Carex rostrata, shore–2.
Carex filiformis, shore–2.
Carex elata, shore–2.
Cladium Mariscus, shore–2.
Phragmites communis, shore–3.
Equisetum limosum, 1–5.

Menyanthes trifoliata, shore–1.
Heleocharis palustris, shore–1½.
Typha angustifolia, shore–1½.
Carex flacca, shore–1½.
Carex rostrata, shore–2.
Carex acutiformis, shore–2.
Carex aquatilis (elatior), shore–2.
Phragmites communis, shore–3.
Equisetum limosum, 1–5.

4. *Semi-Aquatic Species that send up from the Water a strong Aerial Flowering Stem, having also Submerged or Floating Leaves that often differ from the Aerial ones.*

Glyceria fluitans, ½–1½.
Heleocharis multicaulis, ½–1½.
Sparganium natans, 1–3.
Scirpus lacustris, 2–7.

Glyceria fluitans, ½–1½.
Hippuris vulgaris, 1–6.
Scirpus lacustris, 2–6.

5. *Aquatic Species that grow up into the Water from the bottom more than a foot in height, and usually with at least some Leaves, which reach the surface and float there.*

Species of the following genera of Algæ are characteristic of peaty lochs; they cover rocks, other submersed plants, etc., or, more rarely, float in the water of bays, etc.:—Ulothrix, Mougeotia, Zygogonium, Zygnema, and Batrachospermum.

Polygonum amphibium, shore–4.
Apium inundatum, 1–4.
Potamogeton rufescens, 2–10.
Castalia speciosa, 2–10.
Nymphæa lutea, 2–12.
Nymphæa intermedia, 2–12.
Potamogeton polygonifolius, 2–12.
Potamogeton natans, 2–20.
Nymphæa pumila, 7–15.

The following genera of Algæ are characteristic of lowland lochs, and masses of them often float at the surface:—Enteromorpha, Cladophora, Spirogyra, and Œdogonium.

Polygonum amphibium, shore–4.
Apium inundatum, 1–4.
Ranunculus peltatus, etc., 1–7.
Potamogeton heterophyllus, 1–8.
Potamogeton rufescens, 2–10.
Castalia speciosa, 2–10.
Nymphæa lutea, 2–12.
Potamogeton polygonifolius, 2–12.
Potamogeton natans, 2–20.

6. *Aquatic Species that grow up into the Water from the bottom usually more than a foot in height, but never or rarely producing leaves that float on the surface.*

PEATY MOORLAND LOCHS—*contd.*

Bryophytes on submerged rocks often abundant, especially the following species: Blindia acuta, Eurhynchium rusciforme, Fontinalis squamosa, F. antipyretica, Scapania undulata, Nardia emarginata, N. compressa, etc.

Utricularia intermedia, ½–3.
Scirpus fluitans, 1–5.
Callitriche hamulata, 1–10.
Juncus fluitans, 1–10.
Myriophyllum alterniflorum, 1–10.
Potamogeton pusillus, 2–10.
Utricularia vulgaris, 1–15.
Potamogeton Zizii, 3–15.
Potamogeton crispus, 2–20.
Potamogeton lucens, 3–20.
Potamogeton prælongus, 5–20.
Potamogeton perfoliatus, 5–20.
Chara fragilis, v. delicatula, 2–25.
Nitella opaca, 3–30.
Fontinalis antipyretica, shore–35.

NON-PEATY LOWLAND LOCHS—*contd.*

Bryophytes on submerged rocks almost absent, but the following species sometimes occur:—Blindia acuta, Eurhynchium rusciforme, Fontinalis antipyretica, etc.

Ranunculus circinatus, etc., 2–8.
Zannichellia palustris, 2–8.
Potamogeton flabellatus, 2–8.
Potamogeton filiformis, 2–8.
Myriophyllum alterniflorum, 1–10.
Callitriche autumnalis, 2–10.
Potamogeton Friesii, 2–10.
Myriophyllum spicatum, 2–10.
Ceratophyllum demersum, 2–10.
Nitella translucens, 2–10.
Anacharis Alsinastrum, 2–10.
Potamogeton obtusifolius, 2–10.
Potamogeton pectinatus, 2–12.
Utricularia vulgaris, 1–15.
Chara fragilis, 1–15.
Potamogeton pusillus, 2–20.
Potamogeton crispus, 2–20.
Potamogeton Zizii, 3–20.
Potamogeton lucens, 3–20.
Potamogeton prælongus, 5–20.
Potamogeton perfoliatus, 5–20.
Chara fragilis, v. delicatula, 2–25.
Chara aspera, 2–25.
Nitella opaca, 3–30.
Chara hispida, v. rudis, 10–35.
Fontinalis antipyretica, shore–40.

7. *Aquatic bottom-carpeting Species, usually but a few inches high (excluding flowering stalks).*

Heleocharis acicularis, shore–4.
Subularia aquatica, shore–4.
Littorella lacustris, shore–5.
Pilularia globulifera, ½–3.
Lobelia Dortmanna, ½–6.
Isoetes lacustris, 2–20.

Heleocharis acicularis, shore–4.
Littorella lacustris, shore–5.
Elatine hexandra, shore–8.

It should be mentioned that the plants in the local lists hereafter are not arranged in systematic order, but more or less in accordance with the position they occupy in the loch, usually beginning with the bottom-carpeting species.

PART III.—THE LAKES.

I.—AREA IV.

We may begin the examination of the lochs of Area IV. (p. 65) at Loch Doon; from there we proceed to those lochs on the hills to the W. and S.W. of Loch Doon; thence by way of Lochs Dee, Trool, Grennoch, Whinyeon, Ken, Lochinvar, etc. to Loch Dungeon, and finish our tour on the eastern slopes of the Rhinns of Kells.

Loch Doon is the largest sheet of fresh water in Scotland south of Loch Lomond. It is 5½ miles long by 1 mile wide in the widest part; the surface is 673 feet above sea level, and the maximum depth is 100 feet, but generally it is not over 50 feet deep. Its water is rather peaty, and its shores rocky or stony, with an occasional sandy bay. Its surroundings are almost treeless, although fig. 1 appears to belie this statement; at that place, however, (Portmark) there are a few trees near a shepherd's house. Everywhere the loch is surrounded by mountains and moors, the greater part of which are covered by grass-like associations of plants. The population of the district is extremely scanty; the only houses are those of shepherds or small farmers, and the total number of these will scarcely exceed a dozen throughout its whole drainage area. The scenery, as may be gathered from the foregoing remarks, is wild and lonely; yet the broad outlines of the loch, flanked by mountains picturesquely silhouetted, give it a grandeur peculiarly its own.

The shores and margins of this loch are, for the major part, entirely bare of aquatic vegetation. Indeed, the erosive power of the waves on the rocky margins allows no opportunity for the development of aquatic plants; and in the sandy bays that occur here and there, the same power, acting on the shifting sand, prevents any considerable growth of vegetation even in such places. Occasionally in pools situated on large rocks or in sheltered creeks a few specimens of Carex Goodenovii or Phalaris arundinacea may be seen. A few of the same species, with scattered specimens of Juncus lamprocarpus, J. acutiflorus, and J. supinus, occur on wet sandy places; and between the rocks, here and there, patches of Sphagnum cymbifolium or Fontinalis antipyretica may be observed, but always in small quantity. Nor do the littoral rocks bear any wealth of Bryophytes. Of the few that do occur, Eurhynchium rusciforme, Bryum alpinum, Blinda acuta, Orthotrichum rupestre, Grimmia apocarpa, Brachythecium rivulare, and Rhacomitrium aciculare are the most common. On the whole, it may broadly be stated that Loch Doon is destitute of either an aquatic or semi-aquatic marginal flora.

At a few feet above the normal water level quantities of lichens clothe the rocks and give the littoral a distinctive character. The most abundant of these lichens are Lecidea geographica, Parmelia omphalodes, and Sphærophoron coralloides. The first mentioned is so plentiful, and so completely does it overgrow the rocks, that many parts of the shore are for considerable distances coloured bright yellow, and the zone to which its abundance is restricted presents a remarkable appearance. This rocky zone is in reality at the ancient water level of the loch previous to a reduction of its level by about 7 feet some 150 years ago. This lowering of the level was brought about by the construction of a tunnel for the effluent instead of the natural outflow, for the double purpose of reclaiming land at the margin and admitting salmon to the loch. Why the Lecidea should be so abundant at the old water level I am unable to explain.

I dredged this loch in a great many places from end to end, but beyond an average depth of about 7 feet no living plants could be obtained from the bottom. Yet in suitable places the bottom from 2 to 7 feet deep often bears an abundant vegetation, which occasionally may be continued into the shallower water: Littorella lacustris, for example, is plentiful in a few sheltered sandy creeks. The extinction of the submersed Phanerogams at so shallow a depth as 7 feet is distinctly remarkable because it is not brought about, as in some cases (*ante*, p. 1015), by the discoloration of the water. Here the bottom can be seen at a depth of 7 feet when looking over the side of a boat, without the use of any apparatus beyond shading the eyes with one's hat in order to shut out the light reflected from the surface of the water. Reasoning, therefore, from similar cases of translucency, some vegetation should extend to a depth of 28 feet or more.*

It has already been indicated (p. 66) that the grass-like associations of plants which cover the moors and mountains have an influence upon the flora of the lochs in this Area. At the first consideration one would imagine that the influence exercised upon the bottom flora of a loch by the substitution of grass-like plants over the moors, instead of associations of Ericaceæ, would be that of less peat-extract getting into the water. Such, however, is scarcely the case, because the moors have an abundance of ancient peat below the grass, formed there previous to the development of the sheep-rearing industry. The influence is caused in a way one would little expect. In winter the dead leaves of the grass-like plants covering the moors, chiefly Molinia cærulea, which grows very luxuriantly here, but also Nardus stricta, Scirpus cæspitosus, etc., are blown or washed into the burns and drains, and are thence carried into the lochs. There, owing to the antiseptic action of the peaty water, these remains do not readily decay, but accumulate from year to year and become spread out over the loch-bottom in enormous quantity, and, of course, this stratum of dead grass, wherever it lies, prevents the growth of a bottom flora. The depth to which its influence extends varies somewhat in different lochs, and even in any one particular loch. In Loch Doon, at the south end, where the loch receives its principal supply of this grass from the rivers Gala Lane and Carrick Lane, it spreads over the bottom to within 5 feet of the surface of the water, and at other parts of the loch to about 7 feet below the surface. From these depths it is spread over the whole loch-bottom more or less. Even at a depth of 50 feet the dredge came up choked with this deposit, which in such deep water is almost black, but not of a particularly evil odour. The deposit of this substance in the loch must be the result of the accumulation of many years, through the process of decomposition being so slow in the peaty water. At Loch Stroan (p. 115) a large amount of such dead grass is washed upon the east shore by the winter floods (fig 24). Loch Stroan is a small, shallow loch, and in flood-time there is a very considerable current passing through it from the River Dee, so that a portion of the grass must be carried down the river into Loch Ken besides that which is deposited high upon its own shore. Yet, notwithstanding these losses, Loch Stroan has an abundant supply of this material on its bottom. In the neighbourhood of Loch Trool there is much less grass available, and the bottom flora of that loch extends to a depth of 16 feet (p. 112).

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* *The Geographical Journal*, January 1908, p. 68.

The submersed aquatics that flourish in the available zone about the margins of Loch Doon are as follows:—Subularia aquatica, Littorella lacustris, Isoetes lacustris, Heleocharis acicularis, Nitella opaca, Fontinalis antipyretica, Scirpus fluitans, Juncus fluitans. All the foregoing species are abundant with the exception of the last mentioned, which, although plentiful in the Gala Lane, is somewhat scarce in Loch Doon. Peplis Portula, a curious submersed form growing to a depth of 3 feet (p. 75), and Eurhynchium rusciforme, at a depth of 3 to 5 feet (p. 93), were both very abundant at the south end of the loch. The following were much less abundant:—Lobelia Dortmanna, Myriophyllum alterniflorum, Sparganium natans, Chara fragilis, var. delicatula, Batrachospermum moniliforme, and B. vagum. Bryophyta and Algæ other than those mentioned were extremely scanty, and the paucity of plants in the marginal zone has already been referred to. Figs. 1 to 3, with their respective descriptions, will afford additional information regarding the general features of this loch. The historic remains on the island in fig. 2 will perhaps not be without interest to some readers. The builders of this castle having constructed it centuries before the artificial lowering of the surface of the loch, were under the necessity of providing its base with masonry capable of withstanding the waves in time of storm, and the superior construction of the lower portion is still well exhibited, although the foundations are partially destroyed.

On the south-west of Loch Doon there is a large and somewhat circular, elevated, treeless moor 3 or 4 miles in diameter, surrounded by mountains on every side and presenting the aspect of some huge amphitheatre in utter ruin. Rugged rock and deep bog vie with one another for possession of the space. Here a gurgling burn divides the combatants; there a broad lane * dashes over its rocky bed with foaming impetuosity; whilst ever and anon a slow, deep, sinuous river winds its labyrinthine course through some level stretch of moss, scarcely more stable than the river itself. Numerous lochs, characterised by stretches of coarse white sand intercalated here and there on their otherwise rocky or peaty shores, are sprinkled over this lonely and wild moor. In some of these lochs, flourish in great abundance two interesting aquatic plants that I have met with nowhere else in Scotland, namely, a truly aquatic form of Ranunculus Flammula (var. natans) and Potamogeton polygonifolius, var. pseudo-fluitans, already mentioned on pp. 72 and 84 respectively.

I shall first describe the general features of these lochs, and then give a list of the plants common to most of them. I was unable to obtain the use of a boat at any of the lochs hereabout, and am therefore not able to give any account of the bottom flora beyond the marginal zone, excepting what could be gleaned from an examination of the remains of such plants found upon the shores.

Loch Recar is one of the largest of the lochs on the above-mentioned moor. It is about a mile across in either direction, and has a very irregular outline. The water is somewhat peaty, but, considering the moorland situation, remarkably clear and bright. The shores are rocky or peaty, but, on the east side particularly, large bays are filled with coarse white sand, which results from the disintegration of the syenitic granite in which this loch as well as neighbouring ones is set. This sand is found chiefly on the eastern shores, in consequence of the erosive power of the waves caused by the prevailing westerly winds. The somewhat scanty vegetation is much more abundant on the western than on the eastern shores, saving that aquatic plants are much more plentiful in the long and narrow neck of water leading to the effluent on the east side than elsewhere in the loch.

Loch Macaterick is a mile south of the last-mentioned loch, and is about the same size; the outline also is very irregular. This loch is almost cut in twain by two promontories which jut out from opposite sides of the shore near its middle. Like Loch Recar, it has a long narrow arm leading to the effluent on the east side; there are also several small islands. The hill Macaterick rises boldly from the south shore; similarly, but less boldly, Maccallum rises from the south of Loch Recar. In the shores, water, and vegetation, this loch also resembles Loch Recar.

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* A stream is often termed a lane in this part of Scotland.

Loch Slochy is half a mile S.W. of Loch Recar, into which it drains. It is of some considerable area, but very shallow, and consequently is almost entirely overgrown with associations of marsh plants, some of which spread over the adjoining boggy moor, so that in many places one has difficulty in discovering where the water ends or where the shore begins. This loch is well on the way towards the formation of another of those deep bogs with which the district already abounds. The most abundant and dominant plants of the deeper marsh are Equisetum limosum and Phragmites communis, with which are mixed a few groups of Scirpus lacustris. Carex rostrata, Heleocharis palustris, Juncus lamprocarpus, and J. acutiflorus dominate the shallow margin, where Juncus effusus also occurs, but less plentifully. Littorella lacustris and Juncus fluitans appear to be the most abundant submersed plants.

Loch Ballochling is a small sheet of water having the same general features as Loch Recar, and is situated a mile north-east of it. It illustrates well the difference between east and west shores, caused by the prevailing westerly winds; the west side has an abundance of plants, whilst the east side consists chiefly of sandy bays almost without vegetation. Carex rostrata, C. filiformis, Potamogeton polygonifolius and its var. pseudo-fluitans are particularly abundant on the west side. Ranunculus Flammula, var. natans, is also very plentiful, especially in the affluent. Two hepatics not generally common on the shores of lakes grew luxuriantly—Pleurozia cochleariformis and Jungermannia inflata.

Loch Goosie is a small loch about a mile west of the last mentioned, and similar to it in general features. Its dominant plants are Phragmites communis and Potamogeton polygonifolius; the beautiful moss Pterogonium gracile was abundant on the dry rocks of the shore.

Loch Brecbowie is a small sheet of water about a mile N.W. of the last mentioned, and being about 1200 feet above sea level, is at a greater elevation than any of the foregoing lochs. It is prettily situated amongst hills, in a pass leading from Loch Goosie to Loch Bradan. Waterhead Hill rises immediately from its east side. The margin is sinuous, and the very narrow zone of shore between the water and the moor is rocky, stony, or sandy; its general features are otherwise similar to those of the preceding lochs. Carex rostrata, Equisetum limosum, Phragmites communis, Lobelia Dortmanna, and Littorella lacustris are its most abundant plants.

Descending northwards from Loch Brecbowie for about a mile, one comes to Lochs Bradan and Lure, which are connected together by a narrow channel. Loch Bradan is nearly a mile long, with a maximum breadth of a quarter of a mile. It is very shallow, the greatest depth being 8 feet. Loch Lure is about a third the length of its neighbour, with a maximum depth of 7 feet. The elevation of these lochs is nearly 1000 feet above sea level. Except for a plantation of conifers on the south of Loch Lure, about the ruins of Craiglure Lodge, these lochs are entirely surrounded by a treeless, grassy moor. Their shores are rocky or stony, and the water is slightly peaty. On an island in Loch Bradan are the ruins of a small castle, but there is now little more to be seen than what is presented by a stone sheep-enclosure. Both lochs have an area of marsh at the west end, but the vegetation is dwarfed, and, like that in the water, consists of the same species as grow in the lochs previously mentioned.

Passing over the hill by way of the little pool, Loch Duh, which contains nothing of particular interest, one crosses the Girvan Water and enters the desolate moor in which are situated Derclach Loch and Loch Finlas, which are connected by a short and narrow channel, and together form the source of the water supply for Ayr. Derclach Loch is a very narrow sheet of water about half a mile long and not more than 12 feet deep. Loch Finlas is also very narrow and shallow throughout the greater part of its length, which is 1½ miles. It widens at each end, and is therefore dumb-bell-shaped. Its surface is 830 feet above sea level, being 7 feet less than Derclach Loch. These lochs have a narrow shore, which is either peaty, stony, or rocky. Their water is clear, but slightly peaty. They have a scanty vegetation, and present nothing of botanical interest beyond a number of plants common to the preceding lochs.

The plants more or less common to all the foregoing lochs, excluding Loch Doon, are as follows:—Lobelia Dortmanna, Isoetes lacustris, Littorella lacustris, Subularia aquatica, Chara fragilis, var. delicatula, Nitella opaca, Sparganium natans, Scirpus fluitans, Ranunculus Flammula, var. natans, Castalia speciosa and its var. minor, Juncus fluitans, Myriophyllum alterniflorum, Potamogeton natans, P. polygonifolius and its var. pseudo-fluitans, Carex Goodenovii, C. filiformis, C. rostrata, Menyanthes trifoliata, Hydrocotyle vulgaris, Equisetum limosum, Scirpus lacustris, Juncus lamprocarpus, J. acutiflorus, J. effusus, Heleocharis palustris, H. multicaulis, Phragmites communis, Caltha palustris and its var. minor, Eriophorum polystachion, Ranunculus Flammula and its var. scoticus, Cardamine pratensis, Batrachospermum moniliforme, B. vagum, Ulothrix æqualis, Zygogonium ericetorum. Numerous Bryophytes were also frequently abundant on the peaty shores, or clothing the rocks at the margins.

Proceeding from the head of Loch Doon towards Loch Enoch by way of the glen drained by the Gala Lane, and lying between the two mountain ranges, of which Merrick, on the west, and Corserine, on the east, are the highest points, one passes over the site from which Loch Doon obtains its chief supply of Molinia cærulea. Here is a stupendous bog 5 miles long by a mile or so wide, almost everywhere treacherous to walk upon, and in some places quite impassable.* A characteristic feature of this bog is the luxuriant growth of Molinia cærulea, which is often about 18 inches high. The same grass also dominates the sides of the hills, but there it is much shorter.

After receiving numerous tributary streams, the Gala Lane for the last three miles of its course is of some considerable size, and only in a few places can it be crossed dry-shod by jumping with alacrity from rock to rock across its bed. Sometimes it passes swiftly down a rocky incline; generally, however, it meanders its tortuous course, slow, deep, and wide. In such places flourishes a vegetation abundant in quantity but poor in variety; or its bottom may be covered with dead grass like that of Loch Doon, in which case no living vegetation occurs. Carex rostrata forms a marginal zone of varying width, and in the water Potamogeton natans, P. polygonifolius, Castalia speciosa, and Juncus fluitans are the ruling, and in fact almost the only, species. The last particularly is so abundant that the slow, deep river appears in places full of it, yet in Loch Doon it is scarce.

Looking from the monotonous and treacherous Molinia-covered glen, the scenery is indeed unique. On the east, Carlin's Cairn, Meikle Craigtarson, Millfire, and Meikle Millyea thrust their grassy flanks, with here and there a steep gray scree of Lower Silurian rock, into the strath below. On the west, Mullwharchar, Dungeon Hill, Craignaw, and Craiglee plunge their rocky and precipitous shoulders of syenitic granite boldly into the insidious bog of the glen. This untamed grandeur is further enhanced by numberless erratic boulders perched on the western sky-line in fantastic variety (fig. 4). On the east, the great ice-sheet has completed its work of rounding off the mountain tops and giving their flanks a symmetrical slope. On the west, glaciation has but half completed its task because of the harder igneous rock, and here one sees to perfection the battle-ground whence one of the mightiest of nature's gladiators has been driven before completing his victory—simply by the softening of the evening breeze. From the strath one climbs to Loch Enoch by way of Pulskaig Burn, nor can I pass this without a word. Imagine some cyclopean staircase,

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* After passing the watershed at the Dry Loch of the Dungeon, the glen continues for another 5 miles, down to Loch Dee.

> "Piled by the hands of giants
> For godlike kings of old,"

lifted into the hypothetical ether, and dropped pellmell into a gully on the face of a rocky and precipitous mountain, and you have some idea of Pulskaig Burn. But it appeals to a botanist by reason of the luxuriant splendour of its rare Bryophytes, as well as by the pleasing scenic effect. Here is a riser of the gigantic stair 20 feet high, now tilted to an angle of 45 degrees, over which the pellucid water swiftly glides in rippling dance to music of its own begetting. Scoured and ground by the rush of gravel in time of spate, the face of the granite is perfectly clean and sparkles in the sunlight. But look to right and left! From that ruined balustrade hang masses of yellow-green or purple Mylia Taylori, interrupted with cushions of Trichostomum tortuosum or Rhacomitrium sudeticum, and, sheltering in the dampness below, the delicate Cephalozia bicuspidata, Heterocladium heteropterum, or Jungermannia Floërkii cover the granite with rare luxuriance. Yon purple-black rock, dripping with water, owes its colour to Andreæa alpina, and above it the bright green capital of a half-exposed column is due to the exquisite Metzgeria hamata, whilst the plinth is wreathed in a purple mass of Pleurozia cochleariformis. Look again! This ruined corbel still supporting the floor of a balconette, from which beads of water drip into the current below, is almost hidden by the wealth of Hypnum molluscum and Breutelia arcuata, whilst the floor itself is covered with a domed mass of the beautiful Sphagnum rigidum. Scrambling upwards over a few steps that have scarcely been misplaced, we come to a semicircular excavation like a reversed ambo. The floor has been hollowed into a deep cavity, and the process of carving is still continued by the whole body of the burn dropping into it in foaming cataract from 8 or 9 feet above. The spray-splashed margins of this agitated pool are carpeted with masses of Blindia acuta, Hypnum scorpioides, Marsupella aquatica, and Campylopus atrovirens, whilst the surrounding chinks and crannies are gray with Anthelia julacea or green with Philonotis fontana. The surrounding drapery is of richest form. Such Diplophyllum albicans! Such Nardia emarginata! But chiefest of all are the glorious masses of Nardia compressa and Scapania undulata that cover the dripping rocks and hang in festoons below. What a list of Bryophytes a botanist might write after a day or two spent here! But clambering on, we pass here a foaming cascade, there a gentle pool, reflecting as a silver mirror the colours of the marginal vegetation—a thing of exquisite beauty—and ever and anon a black, deep hole that almost induces a shudder as the eye catches the faint light glimmering from cavernous recess of horrid rock. Pushing upwards, we reach the top, and here what a sight awaits! Great masses of ancient peat, worn into deep gullies by the storms of ages, almost bare of vegetation, black and grim; and lying beyond, Loch Enoch, with its shores of silver sand, and its clear, sparkling water reflecting the adjacent mountains like a speculum.

Loch Enoch is 1617 feet above sea level, and is the most elevated of a series of unique alpine lochs situated in a singularly rugged mountain district. It occupies a very wind-exposed position, which probably accounts for the sand of its shores being finer than that of other lochs in the district. Its outline is very irregular; and there are several small islands, the largest of which has upon it a small pool, hence the name Loch-in-loch, of which its better-known name—Loch Enoch—is said to be a contraction. There are several bays that have a shore of beautiful white sand produced from the disintegrated syenitic granite of which these mountains are largely composed. Nearly all the lochs of this district possess similar shores of white sand, but that of Loch Enoch is finer than any other, and is prized above all by shepherds, far and near, for the purpose of sharpening their scythes, although those living in this district frequently use that from the nearest loch for the same purpose. The scythe is used for the purpose of cutting the uncultivated Molinia cærulea, called "bog-hay" or "blow-grass" of the moors, for feeding the sheep and cattle during winter, the rough or boggy nature of the ground excluding the use of the modern mowing-machine for this purpose. To sharpen a scythe, a strip of wood about 18 inches long by 3 inches wide is smeared with butter, which is then sprinkled with sand, and used in a similar way to the ordinary whetstone. Others stick the sand to the wood with glue; the latter, however, has to be purchased, whilst the former is a home product of no monetary value.

The shores of Loch Enoch, with the exception of the sandy bays, are rocky, and the water is exceptionally clear and sparkling, although slightly peaty. The flora is very poor in species. On the west side Sparganium natans is abundant in bays; there are also several small associations of Carex rostrata in bays on the west and north sides. Isoetes lacustris, Lobelia Dortmanna, and Littorella lacustris carpet the bottom in places. Juncus fluitans is very abundant, whilst Myriophyllum alterniflorum is scarce; Batrachospermum vagum is abundant, and in some places the submersed rocks are thickly covered with Zygogonium ericetorum or Nardia compressa. The littoral Phanerogams, besides those already mentioned, are extremely scanty, there being merely a few plants of common species here and there. Amongst numerous Bryophytes that were abundant on the littoral the following may be mentioned:—Mnium hornum, Trichostomum tortuosum, Rhacomitrium gracilescens, Jungermannia ventricosa, J. Floërkii, Anthelia julacea, Nardia emarginata, N. compressa, Pellia epiphylla, Diplophyllum albicans, Hypnum scorpioides, etc. Figs. 5 and 6 represent this loch, with the adjacent mountains Merrick and Mullwharchar.

Loch Neldricken.—Proceeding a few hundreds of yards to the south-east of Loch Enoch, one comes to a narrow ridge of rugged rock connecting Dungeon Hill with Craignaw (fig. 9). From this spot, called the Nick of the Dungeon, an excellent bird's-eye view is obtained of Lochs Neldricken and Valley (fig. 7). These lochs are similar in general features to Loch Enoch,—they have clear, brilliant, slightly peaty water, white sandy bays, shores otherwise rocky, and very irregular outlines. The vegetation is also similar, and usually scanty. Loch Neldricken differs from Loch Enoch by having considerable associations of Equisetum limosum, more Myriophyllum alterniflorum, and a few specimens of Glyceria fluitans. On the N.W. side there is a very regularly shaped "murder-hole" (*ante*, p. 1014, figs. 84 and 109), formed in a somewhat circular bay or arm of the loch, the shallow margin of which affords a suitable situation for sedge-like plants. The bottom, I presume, sinks suddenly and regularly like a basin, at some distance from the shore, to a greater depth than these plants can accommodate themselves to; consequently they end abruptly, and present an even circular outline at the place where the water is too deep for further advance (fig. 8). The plants surrounding this "murder-hole" are in three well-marked zones as follows:—Adjoining the shore, Carex rostrata, then a zone of Equisetum limosum, followed by a narrow zone of a plant which, from distant examination with a telescope, was apparently a large form of Carex rostrata, but as specimens could not be obtained, it was impossible to exactly identify the species. Beyond those enumerated, the marginal Phanerogams are very sparse. In many places the sandy shores are covered with patches of Nardia scalaris and Anthelia julacea, and the littoral rocks also are frequently overgrown with Bryophytes common to the district. Fig. 9 gives a representation of a portion of this fine loch from the south shore.

Loch Valley, as already indicated, is adjacent to the last mentioned and receives its outfall. The physical and botanical features are similar to those of the adjacent lochs already described, but it has in addition Carex filiformis and Menyanthes trifoliata. There are several associations of Carex rostrata, and Hypnum fluitans is very abundant on a boggy portion of the shore, whilst Anthelia julacea and Pleurozia cochleariformis are features of other parts. Submersed rocks are frequently covered with such Algæ as Batrachospermum vagum, Ulothrix, Zygogonium, etc. Figs. 7 and 10 illustrate this loch and its surroundings.

Loch Narroch is quite a small circular sheet of water at the east end of Loch Valley. In general features it closely resembles the neighbouring lochs. The rocks of the margin were covered with remarkable quantities of Algæ, chiefly of the genera Batrachospermum, Ulothrix, Zygogonium, Zygnema, and Mougeotia.

Round Loch and Long Loch of Glenhead are both to the south of Loch Valley; they are, however, at a lower elevation and smaller. These lochs are very bare of plants, and are otherwise similar to those recently described. They are not of sufficient botanical interest, so far as I could glean without a boat, to merit further discussion. Fig. 11 illustrates these lochs, and the treeless, wild mountains around them.

Loch Dee, which is 1¼ miles long by ¾ mile wide, and 36 feet deep, is the largest of this series of lochs. The outline is irregular, a peninsula from the south shore and another from the north jutting out so as almost to divide the loch. It is situated at an elevation of 739 feet above sea level, amidst wild and lonely scenery, about 5 miles south of Loch Enoch. Although at a lower elevation, it is similar in general features to that and the neighbouring lochs, excepting that the sand of its shores is not white but of a brownish tinge; the water also differs in being somewhat more peaty. Away from the sandy bays the shores are mostly rocky. The flora is extremely poor, and being composed of the same species as occur in the previously mentioned lochs, need not be specially described. A boat which is kept here was out of repair during my visit, but careful attention to plants washed up on the shore revealed nothing uncommon to the district. Bryophytes abound on the shores and on the exposed rocks. Very conspicuous also are the lichens which cover the numerous rocks by the shore; the most plentiful of these are—Platysma glaucum, Cetraria muricata, Parmelia lanata, P. omphalodes, Alectoria jubata, Sphærophoron coralloides, and Lecanora tartarea. Fig. 12 affords a view of the loch, chiefly its S.W. portion.

Dry Loch, Round Loch, and Long Loch of the Dungeon.—These are small sheets of water, each a few hundreds of yards long, and they are all connected by a stream which first flows out of the Dry Loch, that being the highest of the three; this stream ultimately becomes the River Dee. Their shores are stony or peaty, and their water is slightly peaty but clear. These lochs are situated at the highest and wildest part of the glen (p. 106), between Dungeon Hill and Craignaw, and the scenery around is extremely fine. They have no feature of botanical interest beyond a number of such plants as are contained in the other lochs of the neighbourhood, and such need not, therefore, be independently described.

The plants that flourish in and about this series of lochs, from Loch Enoch to the Dungeon Lochs, are as follows:—Lobelia Dortmanna, Littorella lacustris, Isoetes lacustris, Juncus fluitans, Myriophyllum alterniflorum, Sparganium natans, and Potamogeton polygonifolius, all abundant; Subularia aquatica, Callitriche hamulata, Utricularia vulgaris, U. intermedia, Scirpus fluitans, Sparganium minimum, and Castalia speciosa, var. minor, all more or less scarce. Characeæ are apparently scarce. Batrachospermum, Ulothrix, Mougeotia, Zygnema, Dickieia, etc., are frequently very abundant. Heleocharis palustris, Eriophorum vaginatum, E. polystachion, Carex rostrata, C. Goodenovii, C. filiformis, and Equisetum limosum are all abundant. Menyanthes trifoliata, Juncus effusus, J. lamprocarpus, J. acutiflorus, J. supinus, Carex binervis, C. flacca, var. stictocarpa, and dwarf forms of Ranunculus Flammula, Caltha palustris, Cardamine pratensis, and Hydrocotyle vulgaris are all more or less scarce. The following are some of the most conspicuous Bryophytes that occur, either in the water or clothing the rocks of the shores. A number are distinctly terrestrial forms, yet they constitute such a feature of the shores and are so inextricably associated with the loch that an enumeration of the flora would be incomplete were they excluded:—Sphagnum sp. abundant on boggy shores, Blindia acuta, Grimmia apocarpa, var. rivularis, Rhacomitrium aciculare, Fontinalis antipyretica, Aulacomnium palustre, Pterygophyllum lucens, Philonotis fontana, Brachythecium rivulare, Hypnum fluitans, H. revolvens, H. falcatum, H. scorpioides, H. commutatum, H. cuspidatum, H. uncinatum, Dicranella squarrosa, Scapania undulata, S. sub-alpina, Nardia compressa, N. emarginata, and N. scalaris. The foregoing species occur more or less in water, and the following in drier situations:—Dichodontium pellucidum, Dicranella heteromalla, Dicranum fuscescens, D. Scottianum, Grimmia apocarpa, Rhacomitrium lanuginosum, R. heterostichum, Hedwigia ciliata, Trichostomum tortuosum, Orthotrichum rupestre, Bryum alpinum, Mnium punctatum, Heterocladium heteropterum, Pterogonium gracile, Plagiothecium undulatum, P. elegans, Thuidium tamariscinum, Hypnum cupressiforme, Frullania tamarisci, Pleurozia cochleariformis, Anthelia julacea, Diplophyllum albicans, Mylia Taylori, Pellia calycina, P. epiphylla, etc.

Loch Trool is 246 feet above sea level, and is 1½ miles long by ¼ mile wide, with a maximum depth of 55 feet. It is approached from Loch Dee through a narrow, rugged, and trackless pass about 3 miles long. This loch affords a splendid piece of highland scenery, which is probably unequalled south of Perthshire. Mountains rise from the shores almost throughout its whole length, their lower slopes being clothed with either coniferous (fig. 15) or deciduous-leaved trees. This loch somewhat resembles Loch Oich (*ante*, fig. 40), but is smaller. The water is clear, but slightly peaty. At the west end the margin is formed chiefly by peaty banks; elsewhere, except at the east end, which is flat and boggy, the shores are stony, rocky or sandy, or the steep hillside enters the water directly without the intervention of a shore. The upper portions of the adjacent hills, above the tree zone, are, where the rock is not bare of plants, mostly clothed with bracken and grass associations (fig. 15). The rank growth of the latter is here, however, much restricted, so that, in comparison with Loch Doon there is but a small quantity of dead vegetation available for covering the loch-bottom. Having noticed the relative scarcity of rank Molinia about the neighbourhood of this loch, I was anxious to discover to what depth aquatic plants flourished at its bottom. Careful dredging revealed the fact that the living vegetation here extends to a depth of 16 feet, but at greater depths the dead remains of Molinia, Carex, etc. cover the bottom, and no plants flourish within this zone. The flora of the loch is poor in the number of species, but some of them occur in great abundance. About the west end, at which is the effluent, the loch is narrow, shallow, and bears a considerable marsh vegetation (fig. 14). Beds of Carex rostrata are abundant, and on drier parts of the boggy shore these are gradually or suddenly exchanged for common bog plants. At the east end the affluent passes through an extensive delta, which is overgrown with marsh plants common to the district (fig. 13). Along the shores, Equisetum limosum is abundant, and here and there occur belts of Phragmites communis and Menyanthes trifoliata, whilst Juncus acutiflorus and J. effusus are both well represented. The shore rocks, which are not a particular feature of this loch, bear a number of common Bryophytes. The submerged plants are as follows:—Littorella lacustris, Lobelia Dortmanna, and Isoetes lacustris, all very abundant, and forming a dense bottom-carpet. The last mentioned extends to a depth of 16 feet. Utricularia vulgaris is abundant to a depth of 8 feet. Potamogeton pusillus and P. obtusifolius are abundant to 10 feet deep. Potamogeton polygonifolius, a few plants only. Juncus fluitans is extremely abundant, and Batrachospermum moniliforme grows on stones by the shore. Beyond the plants mentioned, the flora is extremely sparse, consisting merely of a few specimens of common species.

Loch Grennoch, by Cairnsmore of Fleet (not to be confounded with Loch Grenoch or Woodhall Loch near Laurieston), is a fine sheet of water 2 miles long by $\frac{3}{8}$ mile wide, at an elevation of 690 feet above sea level. It is 68 feet deep, and is situated in a somewhat open and wind-exposed position among grass-covered mountains. Its surroundings are treeless, except for the plantation about a small fishing lodge at the south-west end, below Craigronald, which rises immediately from the shore of the loch. The water is very clear, and but slightly peaty. The shore is rocky, with the exception of numerous bays of white syenitic sand. The exposed littoral rocks bear a number of common Bryophytes and lichens, but to no great extent, the most abundant being Hyocomium flagellare, Hedwigia ciliata, Grimmia apocarpa, and Rhacomitrium aciculare. The aquatic flora is very poor in species, and the semi-aquatic plants of the shore are also poor in species and in numbers, the greater portion of the shore being almost devoid of such plants. At the north end there are associations of Phragmites communis, Juncus lamprocarpus, and J. acutiflorus; a little bay on the east side has also a quantity of the first mentioned. On the north-west margin there are associations of Carex rostrata and Equisetum limosum. Groups of Heleocharis palustris and dwarf specimens of Ranunculus Flammula occur here and there all around the loch. Juncus alpinus and a dwarf form of Heleocharis palustris (p. 85) grow upon the drier parts of some of the sandy bays. In certain of these bays the copious sand is blown up into miniature dunes capped with Calluna, etc., resembling those of a sandy seashore on a small scale. The bottom is for the most part very rocky, but there are considerable areas of sand or gravel extending from the margin to a depth of 8 or 10 feet. These areas are usually more or less carpeted with Littorella lacustris, Lobelia Dortmanna, and Isoetes lacustris, most of which are more or less overgrown with Algæ, chiefly Batrachospermum vagum, Ulothrix æqualis, Binuclearia tatrana, etc. (p. 96). These plants, however, bear no external evidence of injury by the Algæ, although Nardia emarginata and Scapania undulata, both of which grow abundantly on submersed rocks, were much injured by the dense growth of such epiphytes upon them. Fontinalis squamosa and F. antipyretica occur in abundance upon the submersed rocks of the margin from the surface to 3 or 4 feet deep. In many places Juncus fluitans is extremely abundant from 2 to 5 feet deep. In some parts, particularly at the south end, Sphagnum subsecundum (p. 90) and Heterocladium heteropterum (p. 93), mixed with Scapania undulata, were abundant at the bottom from 2 to 8 feet deep, an uncommon situation for such plants. They may have been brought into the loch by one of the burns in time of spate, and then become adapted to the submersed environment.

I could obtain no living plants in this loch beyond a depth of about 10 feet, not because of the presence of vegetable detritus, nor of the opacity of the water, but because in deeper and often in shallower water too, the bottom is very rocky. I have noticed in many lochs that a rocky bottom is nearly always destitute of the higher plants, that is, when the bottom could be seen or felt with a pole having teeth at the end, or with a weight attached to a line. By bumping such instruments over the bottom of a loch the vibrations carried to one's hand up the wood or cord give an indication of the constitution of the bottom—mud, sand, gravel, rock, etc. Dredging over a rocky bottom is, of course, impossible, leaving out of the question the certainty of losing the apparatus. The reasons for a rocky bottom within the photic zone being either devoid of plants or supporting very few are probably—(1) want of a suitable substratum in which the plants may root; (2) because of the scarcity of plants, the refuse-eating organisms at the bottom are able to deal with all the organic remains that reach them, so that nothing is left but the excrement of such creatures; this, in turn, is attacked by bacteria, and by these means the rocky bottom is kept clean instead of being covered with mud. A general view of this loch is given in fig. 16.

Loch Fleet is a somewhat oval sheet of water situated about a mile east of Loch Grennoch, and surrounded by treeless hills, excepting on the south-east. It is about $\frac{1}{3}$ mile long by $\frac{1}{4}$ mile wide, 56 feet deep, and 1113 feet above sea level. The margin is rocky, and there is very little shore suitable for the development of littoral Phanerogams. The water is clear and but slightly peaty. The scanty flora is restricted to the common types found at Loch Grennoch.

Loch Skerrow is situated amongst wild, rocky, moorland scenery, 4 miles east of Loch Grennoch at an elevation of 414 feet above sea level. It is a shallow, somewhat triangular loch $\frac{3}{4}$ mile long with a very rocky shore (fig. 18), and clear, slightly peaty water. Its maximum depth is 33 feet, and the bottom is mostly covered with rocks which frequently rise above the surface of the water. The larger of these island-rocks are capped with vegetation of the moorland type, such as Calluna vulgaris, Vaccinium Myrtillus, etc. (fig. 17). More numerous are the rocks which rise to just below the surface of the water. These necessitate caution in navigating a boat, and obviously such a rocky bed greatly hinders dredging operations. Sandy portions of the bottom to a depth of 12 feet bore an abundant vegetation, but of a limited variety; otherwise there was little to be noted, excepting at the margins and in shallow, sheltered bays. The submersed plants were—Littorella lacustris, Lobelia Dortmanna, Isoetes lacustris, Subularia aquatica, Juncus fluitans, Myriophyllum alterniflorum, Nitella opaca, Chara fragilis, var. delicatula, Fontinalis antipyretica, F. squamosa, and Potamogeton polygonifolius, all abundant; particularly so at the S.W. side were Potamogeton polygonifolius, Castalia speciosa, and Nymphæa lutea. The semi-aquatic plants of the littoral zone were—Carex filiformis, very abundant, and replacing C. rostrata to a considerable extent (fig. 19), Carex Goodenovii, Heleocharis palustris, Hydrocotyle vulgaris, Ranunculus Flammula, Juncus lamprocarpus, J. effusus, and Caltha palustris, all very abundant, whilst the following were less abundant—Carex rostrata, C. flava, var. lepidocarpa, Phragmites communis, Menyanthes trifoliata, Equisetum limosum, Galium palustre, and Stachys palustris. The following Algæ were very abundant—Batrachospermum vagum, species of Zygnema, Spirogyra, and Ulothrix, particularly Ulothrix æqualis, var. catæniformis, with which submersed Phanerogams, etc. were thickly covered. The water of some of the little creeks was tinged with Oscillatoria. Masses of gelatinous diatoms such as Dickieia were abundant at the S.W. side, where also Sphagnum cuspidatum was plentiful. Many of the shore rocks were covered with a luxuriant growth of lichens, particularly with Parmelia omphalodes. Noteworthy also was the abundance of Bryophytes upon the littoral rocks and in damp places. The most important of these were—Blindia acuta, Fontinalis antipyretica, F. squamosa, Dicranella squarrosa, D. heteromalla, Rhacomitrium aciculare, Hyocomium flagellare, Pterygophyllum lucens, Heterocladium heteropterum, Sphagnum cuspidatum, and other species, Hedwigia ciliata, Dicranum Scottianum, D. fuscescens, Mnium hornum, M. punctatum, Scapania undulata, S. purpurescens, Marsupella emarginata, Pellia calycina, P. epiphylla, Kantia trichomanes, var. aquatica, Chiloscyphus polyanthos, Diplophyllum albicans, Cephalozia bicuspidata, etc.

Loch Stroan.—The Airie Burn, which flows from the north-east corner of Loch Skerrow, joins the River Dee after flowing northwards for about 2 miles (figs. 20–22). Thence the Dee, impetuous nearer its source, slowly meanders eastwards, deep and wide, through an alluvial flat for about a mile and a half, and then it flows into Loch Stroan.

This loch is about 230 feet above sea level, and its north-west shore consists chiefly of sandy or muddy flats, the result of detrital matter brought into it by the River Dee; this is continuous with the extensive alluvial flat through which the river flows before entering the loch, and is overgrown near the water with Carex rostrata, etc. Farther away from the loch the drier portions are covered with moorland herbage of the grass-like type—Molinia cærulea, Scirpus cæspitosus, Deschampsia cæspitosa, etc. Elsewhere the shores of the loch are stony or rocky, with a gentle inclination, and merge gradually into grassy or heathery moor (figs. 23, 24). Although slightly peaty, the water is clear and bright, so that vegetation at the bottom may be observed through a depth of 10 feet. In many places the stones, etc. from the bottom were thickly incrusted with the green sponge, Spongilla fluviatilis, and some of the sandy areas were abundantly strewn with the large mussel Anodonta cygnea. The Dee is, indeed, a particularly favourable habitat for this mollusc, and some of the country folk add a few pounds annually to their incomes by the sale of the pearls which they frequently find in them. Subsequently, when visiting Carlingwark Loch at Castle-Douglas, I found the sandy-muddy bottom covered in places with enormous quantities of this mussel, some specimens being 7 inches long. Directing the attention of my boatman to this fact, he determined to take the first opportunity for a pearl hunt, having learned the method of search from a resident in the neighbourhood of Loch Stroan, and incited also by the knowledge that the latter had sold a few pearls for £6. His chance soon arrived, as I had perforce to give him a holiday, because I became *hors de combat* from the stings of insects, chiefly clegs, which caused such swelling to my face that I was almost blinded for two or three days. Repairing to the loch, hundreds of mussels were brought ashore by this "worthy," but, to his utter disgust, after a whole day's labour, not a single pearl was found. It may be that the different conditions prevailing in Carlingwark Loch do not readily induce the formation of pearls in the bivalves.

The bottom of Loch Stroan is to a great extent sandy or muddy, but no living vegetation occurs at a greater depth than 20 feet, as one might expect would be the case from a consideration of the clearness of the water. The reason for this is that, beyond depths of from 15 to 20 feet, the loch-bottom is covered with the remains of grass-like moorland and marsh vegetation, chiefly those of Molinia, Carex, and Scirpus, brought into the loch by winter floods, as at Loch Doon (p. 101). The dead remains do not come so near the surface here as at Loch Doon because of the scour caused by the River Dee in flood-time. In this case the bulk of such material is derived from the flat, marshy ground, extending, as already mentioned, from the west shore of the loch. Fig. 24 shows a great bank of this dead substance deposited by winter floods high above the normal water level.

The principal plants at this loch are as follows:—Littorella lacustris, Lobelia Dortmanna, Subularia aquatica, Isoetes lacustris, Apium inundatum, Myriophyllum alterniflorum, Scirpus fluitans (fig. 25), Potamogeton polygonifolius, P. natans, Sparganium natans, Glyceria fluitans, Fontinalis antipyretica, Phragmites communis, Heleocharis palustris, Equisetum limosum, Juncus effusus, Carex rostrata, C. Goodenovii, C. flacca, and Ranunculus Flammula, all the foregoing being abundant. Callitriche hamulata is abundant, sometimes with floating rosettes of leaves. Nuphar pumila is abundant in 8 to 10 feet of water on the south-west side, its semi-transparent submersed leaves being copiously produced at such depths. Juncus fluitans is extremely abundant in the shallow water at the north-west side. Scirpus lacustris (fig. 23) is very abundant, producing at depths of from 3 to 5 feet the grass-like submersed leaves in great luxuriance. Carum verticillatum, a characteristic marsh plant of this district, is abundant (fig. 27). Hypericum elodes (fig. 26) is scarce; Hydrocotyle vulgaris, Epilobium tetragonum, and Galium palustre occur on marshy ground. Nitella opaca, Chara fragilis, var. delicatula, and Ranunculus aquatilis occur, but none of them is abundant. Besides Batrachospermum, the filamentous Algæ were scarce; neither were the littoral rocks and banks conspicuous with Bryophytes, a few of the common forms only being observed to be abundant. [On boulders on the east side of the loch the rare moss Grimmia commutata may be found.—J. M'A.].—Juncus fluitans and Scirpus fluitans, both so plentiful here, are much alike in the barren state and easily confounded, but frequently they can be distinguished at a glance when growing, because the Juncus is usually slightly reddish, whilst the Scirpus is always bright green, without a trace of red.

Loch Whinyeon is somewhat circular in outline, and about ½ mile in diameter. It occupies an exposed position over 700 feet above sea level, 3 miles north from Gatehouse-of-Fleet. The water, which has a maximum depth of 33 feet, is clear, and but very slightly peaty. The shore, which is everywhere stony or rocky, consists chiefly of broken shale (Upper Silurian), the beds of which are frequently very highly inclined. The flora of the shore as well as of the water is extremely poor. The most interesting plants noticed were Alisma ranunculoides, in small quantity, but luxuriant, and a very dwarf form of Chara contraria (p. 90), of which the Messrs Groves, to whom specimens were submitted, write—"We have no specimens exactly like it." Rhynchospora alba grows on boggy patches of the shore, to which it has evidently strayed from the adjoining moor, where, in places, it is the dominant plant. The following Bryophytes were abundant upon the shore:—Sphagnum subsecundum and its var. contortum, Mnium punctatum, Dichodontium pellucidum, Bryum alpinum, B. bimum, Dicranella squarrosa, Trichostomum tortuosum, Hypnum commutatum, H. revolvens, H. scorpioides, H. cuspidatum, H. cordifolium, H. cupressiforme, Grimmia apocarpa, Rhacomitrium aciculare, R. lanuginosum, Fissidens adiantoides, Jungermannia bantriensis, J. pumila, Scapania undulata, Nardia emarginata and its var. aquatica. The other plants noticed were not in dense, wide-spreading associations as frequently happens, but more or less scattered; they are as follows:—Littorella lacustris, Lobelia Dortmanna, Myriophyllum alterniflorum, Juncus fluitans, Potamogeton lucens, P. natans, Glyceria fluitans, Heleocharis multicaulis, H. palustris, Equisetum limosum, Carex rostrata, C. Goodenovii, C. flacca, var. stictocarpa, C. flava, var. minor, Juncus effusus, J. conglomeratus, J. lamprocarpus, Ranunculus Flammula, Mentha sativa, Eriophorum polystachion, and Hydrocotyle vulgaris.

Lochenbreck Loch has a rhomboidal outline, each side being about ¼ mile long. It is situated at an elevation of 651 feet above sea level, amongst the hills, about 7 miles N.N.E. from Gatehouse-of-Fleet, and has the characteristic features of a bare highland loch, modified by a plantation of coniferous trees on its eastern shore. The shores are stony, and the water, which has a maximum depth of 15 feet, is clear, but slightly peaty. The flora is of the ordinary type, excepting an abundance of Heleocharis multicaulis, some of which, growing in water 6 to 12 inches deep, had floating leaves. The western shore has a thin zone of Phragmites communis and associations of Carex rostrata, whilst the following grow not only there, but some of them at other parts of the loch as well:—Lobelia Dortmanna, Littorella lacustris, Isoetes lacustris, Juncus fluitans, Heleocharis palustris, Castalia speciosa, Juncus lamprocarpus, J. bufonius, Ranunculus Flammula, Juncus supinus (erect form 6 inches high), Caltha palustris, Sparganium natans, and Potamogeton polygonifolius. A number of common Bryophytes occur upon the shores, Sphagnum acutifolium being particularly abundant in some of the wet places.

Woodhall Loch, or Loch Grenoch, is 2 miles N.E. of the last mentioned. It is nearly 2 miles long by ¼ mile broad, at an elevation of 173 feet above sea level. Being somewhat wind-sheltered by low hills, and surrounded by meadow, grassy moor, or deciduous wood, it presents the general features of a lowland loch, saving that its water, which has a maximum depth of 49 feet, is slightly peaty. Here and there a gravelly bay occurs, but frequently the moor or meadow land abuts upon the water without the intervention of a shore. Where a strip of shore does occur, it is narrow, stony, and frequently covered with Juncus lamprocarpus and J. acutiflorus. Being provided with a wide but shallow outflow, and fed only by small streams, the level of this loch has but little rise and fall, because in wet weather the water readily escapes, and in a dry season the level is maintained by the shallow effluent. The west side has a reedy or sedgy margin, almost continuous throughout its length, but on the east side the reeds are mostly restricted to the bays. At either end there are large associations of Equisetum limosum, and at the north end the specimens of this plant are very large, rising 3 or 4 feet out of water 6 feet deep. The floor of this loch, from a depth of about 8 feet to the deepest part, is covered with the dead remains of vegetation, which prevents the growth of plants upon that portion of the bottom, as at some other lochs previously mentioned. From this zone of dead material to the margin, the bottom in many places is carpeted with Lobelia Dortmanna and Littorella lacustris. The following plants also occur here abundantly:—Nymphæa lutea, Castalia speciosa, Potamogeton lucens, P. natans, P. polygonifolius, a large Nitella at a depth of from 6 to 8 feet, respecting which the Messrs Groves, to whom specimens were submitted, write: "A large barren form of either N. opaca or N. flexilis." Menyanthes trifoliata, Scirpus lacustris, Phragmites communis, Heleocharis palustris, Carex rostrata, C. filiformis, Juncus effusus, J. acutiflorus, J. lamprocarpus, Ranunculus Flammula, Mentha aquatica, M. sativa and its var. rubra, Spiræa Ulmaria, Comarum palustre, Carum verticillatum, Galium palustre (fig. 30), and Eriophorum polystachion. The following are less abundant:—Heleocharis acicularis, Myriophyllum alterniflorum, Potamogeton prælongus, Juncus fluitans, J. conglomeratus, Iris Pseud-acorus, Deschampsia cæspitosa, Carex Goodenovii, and Lythrum Salicaria.

At some parts of this loch the following successive zones of plant associations were observed, starting from the shore:—(1) Juncus effusus, J. lamprocarpus, J. acutiflorus, and Ranunculus Flammula, all more or less mixed. (2) Carex rostrata or C. filiformis. (3) Heleocharis palustris. (4) Phragmites communis. (5) Equisetum limosum. (6) Scirpus lacustris. (7) Potamogeton natans, P. polygonifolius, and P. lucens, mixed. (8) Nymphæa lutea, Castalia speciosa, and Potamogeton natans, mixed. (9) Carpeting the bottom below these zones, wherever there was space, Lobelia Dortmanna and Littorella lacustris.

From a study of the foregoing details it will be observed that this loch forms a somewhat transitional stage between a typical peaty highland loch and a typical lowland one: figs. 28 and 29 represent some of its features.

Blates Mill Loch is a small circular pool within a few hundreds of yards of the east shore of Woodhall Loch. It is surrounded by a zone of Carex rostrata and Equisetum limosum, the former being next the shore. There are also quantities of Nymphæa lutea, Castalia speciosa, and some other plants common to the district.

Mossdale Loch is a peaty pool ½ mile from New Galloway railway station. It contains a few plants common to the neighbourhood, but, like the last mentioned, it appears to be of no further botanical interest. On the moor east of Mossdale Loch there occurs a particularly fine example of the destruction of forest by wind.

Loch Ken is one of the largest lochs in this part of Scotland, being only exceeded in size by Loch Doon. It is 142 feet above sea level, and has a maximum depth of 62 feet. The loch proper is generally considered to lie between the grounds of Kenmure Castle and the Boat-of-Rhone railway viaduct; this portion is 4½ miles long by ½ mile wide in the widest part. The River Dee joins the loch a little below the viaduct, and thence the combined waters are continued as a narrow lake, in some places, however, ½ mile wide, considerably to the south of Crossmichael. This lake-like portion extends the loch a further distance of over 4 miles, and is usually recognised as a part of the River Dee, although to the uninitiated it belongs to Loch Ken, and must be considered so from a botanical point of view. This sheet of water is thus about 8¾ miles long: it varies in width from 100 yards to ½ mile, and has a drainage area of nearly 300 square miles. Like Woodhall Loch, Loch Ken presents a mixture of the highland and lowland types, not only in its flora and physical conditions, but also in scenic effect, as a comparison of figs. 31 to 40 readily shows. Endowed with charming and picturesque surroundings, which are further enriched by interesting historical associations, it seems strange that this inviting country should attract so small a flow of tourists. In many places the shore consists of stones and rocks, which are usually angular or but slightly waterworn and afford support to a very scanty flora; a narrow strip of such shore usually passes at once into moor, meadow, or wood (figs. 33, 36, 37). In other places the loch is bordered by bog, which makes it difficult to distinguish any line of demarcation between land and water (fig. 35). More rarely, the shore may be sandy, or the water may be bordered by a bank without the intervention of a shore. In that portion of the loch above the railway viaduct vegetation seldom occurs at a greater depth than 6 or 7 feet; beyond that depth, clay, mud, or vegetable detritus covers the bottom, to the exclusion of living plants. In the lower portion, about Parton and Crossmichael, there is in places a bottom flora down to a depth of 12 feet. This fact is accounted for by the great body of peaty water from the River Dee scouring the bottom, and washing the vegetable detritus either down stream or into deeper places.

Near the head of the loch the slight peatiness of the clear water is somewhat modified by the drainage received from the villages and cultivated areas through which the Water of Ken flows, and at that part the variety and luxuriance of the marsh vegetation affords evidence of a greater abundance of food-salts than is usual in peaty lochs. It is also interesting to note that Isoetes lacustris, a plant very impatient of water rich in normal plant food-salts, was not found nearer the head of the loch than the vicinity of Burned Island, whence it occurred, but quite sparingly, down to the viaduct. After the loch had received the peaty water of the River Dee, Isoetes became abundant, and continued so down to below Crossmichael. At the embouchure of the Water of Ken and the Knocknairling Burn, at the head of the loch, there is a very considerable area of alluvium, consisting of gravel, sand, or mud, in a more or less marshy condition. This alluvial flat is covered with a very luxuriant vegetation, as previously mentioned, the dominant plants being Carex rostrata, C. aquatilis, var. elatior, C. vesicaria, Phalaris arundinacea, Deschampsia cæspitosa, Equisetum limosum, Heleocharis palustris, Juncus effusus, J. lamprocarpus, J. acutiflorus, J. bufonius, Plantago lanceolata, Galium palustre, and Ranunculus Flammula. A dense jungle is formed by the colonies of Phalaris, Deschampsia, and Carex elatior, the two former attaining a height of from 4 to 5 feet, and the latter a height of from 4 to 6 feet. The masses of Carex rostrata could be distinguished at a considerable distance, when blown by the wind, by their glaucous leaves; the colonies of C. vesicaria, which attain a similar height, by their green leaves; and the associations of C. elatior by their superior height, and broad, green, flowing leaves, waving in the breeze like a luxuriant field of grain. Although in many places the last mentioned were over 6 feet high, yet the general height of the level top when blown by the wind was 4 feet. The marsh vegetation of the littoral zone at other parts of the loch often grows luxuriantly: the low bushes in figs. 32 and 33 are chiefly Myrica Gale, with a background of Salix aurita, Alnus glutinosa, etc., the Myrica frequently being 5 feet high (fig. 34). At other places a strip of bog, often wide and deep, intervenes between the water and *terra firma*; in such places Eriophorum polystachion and other bog plants thrive (fig. 35). Occasionally a dry stony shore is overgrown with a dwarf prostrate form of Ranunculus Flammula, which roots copiously at the nodes; this resembles the var. pseudo-reptans of Syme, but is rather larger (p. 72). Fig. 39 shows the extent of this plant upon a stony shore, and fig. 40 affords a nearer view of the same. Scirpus lacustris grows very luxuriantly throughout the whole area of the loch (fig. 32). In some places this species was flourishing upon the dry shore, and there growing to a height of 3 or 4 feet (fig. 33). Nymphæa lutea is very abundant in some parts of the loch, particularly near the head, where the surface of the water is covered for hundreds of yards along the margin by its leaves and flowers (fig. 31). In certain situations, particularly near the viaduct, where shelter from wind is provided by adjoining woods, and where the narrowness of the loch prevents the formation of waves, Ranunculus heterophyllus covers the surface of the water with its white flowers and floating leaves, and forms one of the characteristic features of this portion of the lake (figs. 37 and 38).

From the viaduct to below Crossmichael the general features are somewhat similar, although the water is a little more peaty, but, being somewhat remote from hills and moors, the lowland type becomes quite assertive, and the gently inclined shores quickly merge into meadow-land or bog. Here, again, Scirpus lacustris occupies large areas of the margin; there are also numerous large associations of Phragmites communis, Equisetum limosum, Heleocharis palustris, Carex aquatilis, C. rostrata, C. vesicaria, C. Goodenovii, etc. A large barren form of either Nitella opaca or N. flexilis occurs abundantly about and below the embouchure of the Dee: this is the same variety as that found in Woodhall Loch, previously mentioned, and probably it was transported from there by water, as the effluent of Woodhall Loch flows into the Dee near New Galloway railway station.

The submersed plants of Loch Ken are as follows:—Littorella lacustris, Lobelia Dortmanna, Isoetes lacustris, Juncus fluitans, Apium inundatum, Myriophyllum alterniflorum, Fontinalis antipyretica, F. squamosa, Callitriche hamulata, Chara fragilis, var. delicatula, Nitella opaca, which occurs throughout the loch (near Burned Island there are vast beds of it, although it does not extend beyond a depth of 7 feet), the large Nitella previously mentioned, Castalia speciosa, Nymphæa lutea and its var. intermedia, N. pumila, Ranunculus peltatus, R. heterophyllus, Glyceria fluitans, Sparganium natans, Potamogeton natans, and P. polygonifolius. The preceding were all abundant, whilst the following were more or less scarce:—Scirpus fluitans, Subularia aquatica, Potamogeton prælongus, P. lucens, P. obtusifolius. Filamentous Algæ were scarce, but occasionally Cladophora glomerata was abundant on stones down to 6 or 7 feet deep. The plants of the littoral zone are—Scirpus lacustris, Equisetum limosum, Carex aquatilis, C. rostrata, C. vesicaria, C. Goodenovii, Heleocharis palustris, Juncus acutiflorus, J. lamprocarpus, J. effusus, J. bufonius, Menyanthes trifoliata, Comarum palustre, Spiræa Ulmaria, Caltha palustris, Phalaris arundinacea, Deschampsia cæspitosa, Cardamine pratensis, Mentha aquatica, M. sativa, Scrophularia nodosa, S. aquatica, scarce, Equisetum palustre, scarce, Hydrocotyle vulgaris, Ranunculus Flammula and a dwarf prostrate form of it, Carum verticillatum, Eriophorum polystachion, Pedicularis palustris, P. sylvatica, Polygonum Hydropiper, Galium boreale, G. palustre, Plantago lanceolata, Valeriana officinalis, Œnanthe crocata, Angelica sylvestris, Senecio aquaticus, Hypericum elodes, Lythrum Salicaria, Serratula tinctoria, Myosotis palustris, etc. [In the lagoons at Kenmure Holms, which are connected with Loch Ken, are Carex elongata, Lysimachia vulgaris, Lythrum Salicaria, Potamogeton obtusifolius, Alisma Plantago, Callitriche stagnalis, Ranunculus Lenormandi, Scirpus sylvaticus, and Thalictrum flexuosum.—J. M'A.] The Bryophytes are scarce or altogether absent on many parts of the shore, excepting in boggy places, where the usual forms, such as species of Sphagnum, etc., abound. The upper portion of the loch is more favourable for the growth of these plants, but even there they do not form a conspicuous feature of the shore. The following were observed in fair abundance:—Grimmia apocarpa and its var. rivularis, Rhacomitrium aciculare, Bryum alpinum, Amblystegium filicinum, Bartramia ithyphylla, Camptothecium sericeum, Hypnum cupressiforme, Neckera crispa, Philonotis fontana, Blasia pusilla, Jungermannia bantriensis, Pellia epiphylla, etc. [Bryum filiforme, Hypnum sarmentosum, H. Patientiæ, Cryphæa heteromalla, Grimmia subsquarrosa, G. Hartmani, and Orthotrichum rivulare grow on stones by the shore, whilst several species of Sphagnum are abundant. Leskea polycarpa, Helicodontium pulvinatum, and Scleropodium cæspitosum flourish on tree trunks in Kenmure Holms.—J. M'A.]

[Near the embouchure of the Shirmers Burn, which is about 2 miles from the head of Loch Ken, on the east side, there is a bank in the loch over which the water is quite shallow. On this raised portion of the bottom submersed plants can be easily seen when sailing over it in a boat. Between Ken Bridge and Loch Ken there is a great extent of alluvial ground upon either side of the River Ken, yielding a large quantity of excellent meadow hay, and that without manure, to the people of New Galloway and the farmers on the Kenmure estate. In time of flood all this extensive flat is covered with water by the overflowing of the River Ken and by the damming back of the water of Loch Ken, caused by the peculiar way in which the River Dee enters Loch Ken immediately below the railway viaduct. This river enters the loch at such an angle that its powerful current is directed against the more gentle downward flow of the loch, and this causes the damming back of the water of Loch Ken as far north as the Kenmure Holms, which are thus enriched by a valuable deposit of mud every time that a flood occurs. This accounts for the luxuriant vegetation at the head of the loch referred to on p. 121.—J. M'A.]

Barscobe Loch is about 3 miles N.E. of New Galloway. It is about ¼ mile long, and is situated in the midst of a treeless, hilly grass moor, which everywhere, excepting where bog occurs, meets the water, so that there is no shore. The water is quite clear and scarcely peaty. On the east side there are thin beds of Carex rostrata, and on the west side associations of Scirpus lacustris and Carex rostrata. On grassy bogs which occur here and there at the margin the usual marsh plants are found. The flora consists of plants common to the district, and need not be especially enumerated, nothing of particular interest being noticed.

Loch Brack is a mile N.E. of Barscobe Loch, and is similar to it in general features, but smaller. Between the grass moor and the water a narrow zone of stony shore overgrown with Juncus acutiflorus intervenes more or less all around the loch; at the base of these plants quantities of Scapania sub-alpina find a congenial habitat. There are also a number of commoner Bryophytes upon the shores, and an average number of common Phanerogams occur, but nothing of special merit was observed.

Loch Howie is 2 miles N.E. of Barscobe Loch, and is larger than it, being $\frac{3}{4}$ mile long by $\frac{1}{8}$ mile wide, and lying S.W. and N.E. The surface is 757 feet above sea level, and the maximum depth is 39 feet. In general features it, again, resembles Barscobe Loch. At the S.W. end there are a few plants of Phragmites communis; these also occur, but much more abundantly, at the N.E. end, but they are all small specimens, none standing more than 3 feet above the water. There is also a small association of Scirpus lacustris at the N.E. end. Carex filiformis is very abundant at this loch, occupying situations that are usually taken up by Carex rostrata. Besides a number of common plants, no other features of interest were noted here.

Loch Skae is a small oval loch about $\frac{1}{4}$ mile long, situated $\frac{1}{2}$ mile E. of Loch Howie, at an elevation of 864 feet above sea level. The maximum depth is 35 feet. The general flora is similar to that of the three lochs just mentioned, but the physical features are different. The surrounding moors have more heather and peat; the scenery, particularly on the east, is rocky and wild, the hill rising steeply above the loch; the water is a little more peaty, and the east shore is rocky or stony. Isoetes lacustris, Utricularia intermedia, and Potamogeton polygonifolius appear to be more abundant here than at the other three lochs. The rocks on the east shore are overgrown with mosses, chiefly Hypnum cupressiforme and Rhacomitrium aciculare. There are associations of Phragmites communis, Carex rostrata, and C. filiformis.

The chief plants more or less common to the four last-mentioned lochs are—Littorella lacustris, Lobelia Dortmanna, Isoetes lacustris, Nitella opaca, Juncus fluitans, Myriophyllum alterniflorum, Utricularia intermedia, Potamogeton lucens, P. natans, P. polygonifolius, Castalia speciosa, Glyceria fluitans, Scirpus lacustris, Equisetum limosum, Phragmites communis, Heleocharis palustris, Menyanthes trifoliata, Carex filiformis, C. rostrata, C. Goodenovii, Juncus lamprocarpus, J. acutiflorus, J. effusus, Hydrocotyle vulgaris, Ranunculus Flammula, Carum verticillatum, Mentha sativa, Galium palustre, Pedicularis palustris, Philonotis fontana, Aulacomnium palustre, Hypnum falcatum, H. scorpioides, H. fluitans, H. cuspidatum, H. cupressiforme, Rhacomitrium aciculare, Scapania sub-alpina, various species of Sphagnum, etc. Filamentous Algæ are scarce everywhere.

Lochinvar is 3 miles N.E. of Dalry. It is about ½ mile long by ⅓ mile wide, and is situated at an elevation of 736 feet above sea level, in a depression of a hilly, grass and heather moor. The scenery around is bare, desolate, and, with the exception of a few conifers about the gamekeeper's house, treeless. The water, which is the source of the public supply for Dalry, is slightly peaty but very clear, and its maximum depth is 10 feet. Nearly everywhere the moorland vegetation approaches to the water's edge, so that there is practically no shore, unless it be a narrow zone of stones or rocks (fig. 41). The bottom is rocky, save some patches of sand. and, with the exception of a few species which are abundant in isolated places, the flora is extremely poor. There are no associations of marsh plants about the shores; such of these plants as do occur are either as scattered specimens, or in a few very small groups,—Carex rostrata, Juncus lamprocarpus, J. effusus, Heleocharis palustris, and Ranunculus Flammula being the chief species. On an island, there is a quantity of Phalaris arundinacea overgrowing the fallen remains of a small castle. The submersed plants are more interesting. Here and there Lobelia Dortmanna or Littorella lacustris scantily carpets the bottom, particularly at the east end, where there is a little sand. Utricularia vulgaris, Myriophyllum alterniflorum, and Fontinalis antipyretica are abundant, whilst Juncus fluitans is not abundant. Strange to say the following Potamogetons were all plentiful:—P. pusillus, P. perfoliatus, P. Zizii, and a very long-leaved form of P. lucens. No other plants worth noting were found here.

Loch Dungeon is 7 miles N.W. of Dalry, at an elevation of over 1000 feet above sea level, and near the cliff at the west side it attains a depth of 94 feet. Beautifully situated at the base of rocky and precipitous mountains, it forms a magnificent, although treeless, piece of highland scenery, wild in the extreme, particularly on the south and west, where the mountains rise almost perpendicularly from the water's edge (figs. 42 and 44). This loch is irregularly shaped, being almost cut in twain at one part by a rocky promontory from the south shore, and by gravel from a moraine, washed into the loch by the Hawse Burn, forming a peninsula or alluvial cone from the north-west shore (fig. 43). The loch is about ¾ mile long by ¼ mile broad. Its water is extremely brilliant and clear, although of a steely-gray colour, and its shores are mostly rocky or stony. Excepting associations of Equisetum limosum and Phragmites communis (fig. 44) in some of the bays, the littoral flora is very scanty. Potamogeton polygonifolius and Juncus fluitans were the only submerged Phanerogams occurring in abundance near the margin, but as there was no boat available, I am unable to state what the result of dredging might have been. The submersed rocks near the shores, as well as those exposed, frequently exhibited a wealth of Bryophytes: Scapania undulata, Nardia compressa, and N. emarginata were particularly luxuriant on many submersed rocks, as well as upon those dripping with water from the cliffs above. By their charm of colour and exuberant growth, the following were very conspicuous at the western margin of the loch:—Breutelia arcuata, Trichostomum tortuosum, Rhacomitrium protensum, R. lanuginosum, Hyocomium flagellare, Anthelia julacea, and various species of Sphagnum, particularly S. cymbifolium. Lichens were also abundant on the exposed rocks, especially a species of Collema. In some places submersed rocks were covered with a felty, mat-like growth of Algæ, which, upon careful examination, proved to be a mixture of three Myxophyceæ—Scytonema mirabile, Stigonema ocellatum, and Dichothrix Nordstedtii.

Loch Minnoch is a mile N. of Loch Dungeon. It is only ¼ mile long, and is beautifully situated amidst rugged hills. The water is very clear, being, in fact, that of Loch Dungeon, which flows into it by the Hawse Burn. This burn, which enters the loch on its south side, has brought in a large amount of detrital matter, causing a shallow area and a considerable bog on that side of the loch (fig. 45). This shallow part is overgrown with Equisetum limosum, etc., whilst the bog, which is covered with appropriate vegetation, merges imperceptibly into moor. The west shore is peaty, and it, together with the south shore, forms a suitable habitat for a considerable number of plants, such as associations of Scirpus lacustris, Phragmites communis, Equisetum limosum, Carex rostrata, Heleocharis palustris, Eriophorum polystachion, E. vaginatum, as well as mixed groups of common but less dominant plants. The north and east shores are rocky and bear a very scanty vegetation. Rhacomitrium aciculare and Blindia acuta are abundant on submerged rocks; so also is an aquatic form of Catharinea undulata, which covers submerged rocks to a depth of a foot or more. Dicranella squarrosa, Hypnum vernicosum, H. scorpioides, and others are common on the shores.

Loch Harrow is rather larger than the last mentioned, and about ½ mile north of it. The surface is 812 feet above sea level, and the maximum depth is 29 feet. The shores are more stony and there are fewer associations of littoral plants, otherwise it is similar to Loch Minnoch. The moor about the three last-mentioned lochs is mostly covered with grass-like associations, Molinia cærulea being the most abundant. The dominant plants of these lochs are as follows:—Subularia aquatica, Lobelia Dortmanna, Littorella lacustris, Isoetes lacustris, Scirpus fluitans, Juncus fluitans, Glyceria fluitans, Fontinalis antipyretica, Potamogeton polygonifolius, P. natans, Scirpus lacustris, Phragmites communis, Equisetum limosum, Heleocharis palustris, Carex rostrata, C. flava, Juncus acutiflorus. J. lamprocarpus, J. effusus, Menyanthes trifoliata, Eriophorum polystachion, E. vaginatum, Ranunculus Flammula, and the Bryophytes and lower Cryptogams already mentioned.

In the paucity of species which comprise their flora, the three last-mentioned lochs agree with those on the Merrick range a few miles to the west. The scarcity of water-birds about these and other mountain lochs is probably a factor to be considered when forming a theory to account for the poverty of species in their flora. Doubtless mountain lochs offer an inhospitable asylum to the majority of our water-fowl. That such birds are active agents in the distribution of aquatic plants is beyond doubt. They are also great destroyers of the less robust vegetation, especially in shallow water, and are frequently the cause of the sudden disappearance of an association of small plants from some particular part of a shore. To cite examples, I have known Scirpus setaceus quite obliterated from a sandy shore in one season, probably by black-headed gulls. On the other hand, I have observed new additions to the flora of a loch which were probably introduced there by birds. Such changes amongst the minor plants of a loch are no doubt constantly occurring (p. 152).

II.—Area V.

Having now passed, by means of a circuitous and zigzag route, over the majority of the lochs situated in N.W. Kirkcudbrightshire, where the highland type predominates, let us leave this "Land of the mountain and the flood!" and beginning at Loch Corsock, examine S.E. Kirkcudbrightshire (p. 66), where many of the lakes are lowland in character.

Loch Corsock is a somewhat triangular sheet of water, about $\frac{1}{3}$ mile long, situated in an upland district, whose moorland character has been modified by cultivation. It lies about 6 miles north of Crossmichael, at an elevation of 540 feet above sea level, and the water is somewhat peaty. The western shores are flat and muddy or peaty, and have an extensive vegetation, whilst the eastern shores are rocky and stony, with only a few plants. On the south-west side there is an extensive marsh, now partially drained (fig. 46). The west, north, and north-east sides are clothed with coniferous wood, and there is also a small plantation of the same kind on the south side. The loch is therefore wind-sheltered to a considerable extent although open to the south-west (fig. 46). The water of this loch was low owing to drought at the time of my visit, and the margin being gently inclined, a considerable area normally under water was consequently exposed. In many places such exposed portions consisted of bare peat or mud, but at other parts where the plants, normally submerged, readily adapt themselves to terrestrial circumstances—for instance, Littorella lacustris, Polygonium amphibium, etc.—the exposed mud was thickly covered by them (fig. 47). Here, as in other instances that I have frequently observed, sheep were grazing upon the exposed Littorella. The shepherds do not approve of this kind of food for their sheep, having an empirical belief that "this grass" is liable to cause liver-fluke in the animals. When one calls to mind the life-history of Distomum hepaticum, it seems quite likely that it would very readily occur in the encysted stage upon exposed Littorella, and would thus freely gain access to the bile-ducts of sheep that had fed upon that plant. Alisma ranunculoides was abundant; many specimens of it were flowering at a depth of 3 feet below the surface (p. 81); it was also flowering freely in the normal terrestrial condition around the margins. The following plants were more or less abundant:—Littorella lacustris, Lobelia Dortmanna, Isoetes lacustris, Myriophyllum alterniflorum, Apium inundatum, Nitella opaca, Chara fragilis, var. delicatula, Juncus fluitans, Ranunculus heterophyllus, Sparganium natans, Utricularia vulgaris, Castalia speciosa, Nymphæa lutea, Potamogeton polygonifolius, P. natans, Fontinalis antipyretica, Menyanthes trifoliata, Polygonum amphibium, Comarum palustre, Alisma ranunculoides, Carex rostrata, Carex flava, Heleocharis palustris, Peplis Portula, Montia fontana, the last two in both aquatic and terrestrial forms; Polygonum Hydropiper, Myosotis palustris, Juncus conglomeratus, J. acutiflorus, J. effusus, Ranunculus Flammula, Mentha sativa, Hydrocotyle vulgaris, Caltha palustris, Senecio aquaticus, Galium palustre, Carum verticillatum, Spiræa Ulmaria, Scutellaria galericulata, Phalaris arundinacea, and Plantago lanceolata. Hypnum fluitans, H. scorpioides, H. cuspidatum, and Fontinalis antipyretica were abundant in the water or in wet places, whilst Grimmia apocarpa and Hypnum cupressiforme covered the rocks on the east shore; otherwise Bryophytes were scarce.

Loch Roan is a small, somewhat triangular sheet of water, 2 miles north of Crossmichael. The west, north, and east margins are clothed with wood, chiefly coniferous, to the water's edge, whilst the south shore abuts upon meadow-land. Where the shores are gravelly or sandy there is little vegetation, but where boggy the usual marsh plants occur (fig. 48).

This is the reservoir for the water supply of Castle-Douglas, and presents little of botanical interest beyond a few common plants, such as associations of Carex rostrata and Equisetum limosum upon the south shore. Hypericum humifusum in dry places and Anagallis tenella on wet sand (fig. 49) were abundant on the west shore, both being unusual members of a shore flora. The latter was especially noticeable because it grew in pure patches, instead of straggling amongst other vegetation as is its usual habit, a fact due to the paucity of competing species. Although this is the reservoir for Castle-Douglas, yet cattle have free access to the water from the grazing grounds to the south, and in many places the shore was filthy with the excrement of these animals. This is a feature too common with the water supply of small towns, which, in the interest of public health, should be safeguarded against.

Loch Erncrogo is about a mile north-east of Crossmichael. It is a small loch of the lowland type about ⅓ mile long, and being more or less surrounded by marsh, there is little shore. Outside the zone of bog, rich agricultural land prevails, excepting on the west side, where there is a plantation of conifers. The chief features here are the great associations of Carex rostrata (fig. 50), beyond which the shallower areas of the loch, particularly at the north end, are overgrown with Castalia speciosa, Nymphæa lutea, and Equisetum limosum. As the water was more or less unapproachable by reason of the bog, and as no boat was available, I am not able to indicate all the submerged plants. Those of the marginal zone are chiefly as follows:—Littorella lacustris, Nymphæa lutea, Castalia speciosa, Potamogeton natans, Scirpus lacustris, Equisetum limosum, Heleocharis palustris, Menyanthes trifoliata, Comarum palustre, Sparganium ramosum, Iris Pseud-acorus, Carex rostrata, Œnanthe crocata, Spiræa Ulmaria, Ranunculus Flammula, Lythrum Salicaria, Phalaris arundinacea, Myosotis palustris, Veronica Beccabunga, Mentha sativa, M. aquatica, Stachys palustris, Carum verticillatum, Eriophorum polystachion, Caltha palustris, Galium palustre, Juncus effusus, J. acutiflorus, J. lamprocarpus, Plantago lanceolata, etc. These plants were more or less intermingled, and not in definite associations of one kind, excepting in the case of Carex rostrata and Equisetum limosum. This, I suppose, is due to the gentle inclination of the boggy shore towards the water, and to the general conditions being equally agreeable to many species without being particularly favourable to a few only.

Loch Dornell is also a small loch, and occupies a somewhat exposed situation in an agricultural and moorland district 2 miles west of Crossmichael. The water is very clear, the shores are stony, and, besides associations of Carex rostrata and Phragmites communis in the bays, there is no great development of the littoral flora. Nearly everywhere the stony shore has a thin, narrow zone of Juncus articulatus, often mixed with Ranunculus Flammula at the margin of the water (fig. 51). Besides those already mentioned, the chief species of this loch are as follows:—Littorella lacustris, Lobelia Dortmanna, Isoetes lacustris, Juncus fluitans, Potamogeton prælongus, P. polygonifolius, P. lucens, Nymphæa lutea, Castalia speciosa, Equisetum limosum, Iris Pseud-acorus, Mentha aquatica, Myosotis palustris, Polygonum Hydropiper, Veronica scutellata, Hydrocotyle vulgaris, etc.

Meikle Dornell Loch is a small circular pool ½ mile west of the last mentioned, and connected with it by a burn. This little loch is surrounded by low hills, and the water is bordered by peaty banks, so that no shore intervenes between it and the moor. It is almost surrounded by a belt of Phragmites communis. There are also a few plants of Scirpus lacustris. A number of species common to the last-mentioned loch abound here also.

Loch Glentoo is 4 miles west of Castle-Douglas. It lies in a hollow of the moor, and appears to have occupied a much larger area at one time, if one may judge by the extent of low, marshy ground around it. The margins of this loch are treeless and its water is rather peaty. From the north and west shores outwards it is half overgrown with great beds of Phragmites communis mixed with Scirpus lacustris, and about the shore Carex rostrata and C. filiformis abound (fig. 52). At the south-west end the growth of marsh vegetation is very dense, and merges gradually into moor through an area of bog. Occasionally the shore is stony, but more frequently only a peaty bank divides the water from the moor. The flora resembles that of the next loch.

Loch Bargatton occupies an open position on the moor ½ mile south-west of the last mentioned. It is somewhat circular in outline, and the water is peaty. The eastern shore is stony and rocky, and comparatively bare of plants. The western side is overgrown with dwarf Phragmites communis, which also occurs in bays at other parts of the loch.

This loch and Loch Glentoo, although at an elevation of only about 200 feet above sea level, resemble lochs of a highland type in their floras, because of their exposed position on the open moor and their peaty water. Shore rocks were sometimes freely coated with Grimmia apocarpa, Hypnum cupressiforme, Orthotrichum rupestre, etc., whilst common bog mosses, particularly various species of Sphagnum, were occasionally abundant. In tiny pools upon the shores grew Chiloscyphus polyanthos, var. rivularis, but otherwise Hepatics were scarce. The other plants more or less common to these two lochs are as follows:—Subularia aquatica, Lobelia Dortmanna, Littorella lacustris, Isoetes lacustris, Myriophyllum alterniflorum, Juncus fluitans, Chara fragilis, var. delicatula, Potamogeton prælongus. P. polygonifolius, P. lucens, P. crispus. P. perfoliatus, Nymphaea lutea, Castalia speciosa, Phragmites communis, Scirpus lacustris, Equisetum limosum. Carex rostrata, C. filiformis, C. flava, var. lepidocarpa, C. Goodenovii, Heleocharis palustris, Menyanthes trifoliata, Comarum palustre, Juncus articulatus, J. effusus, Caltha palustris, Galium palustre, Hydrocotyle vulgaris, Ranunculus Flammula, Scutellaria galericulata, Narthecium ossifragum, Lycopus europæus, Lysimachia vulgaris, Rhynchospora alba. Cardamine pratensis, Spiraea Ulmaria, Pedicularis palustris, Mentha sativa, Eriophorum polystachion, etc.

Carlingwark Loch forms a pleasing addition to the prosperous little town of Castle-Douglas (fig. 53), imparting an impression of repose to the clean and well-ordered streets. It is ¾ mile long by ⅓ mile wide, and has a maximum depth of 17 feet, but over a considerable portion of its area the depth is less than 8 feet. The surface is 143 feet above sea level. The loch is connected with the River Dee by a narrow canal which is about 1½ miles long. This canal was cut for the transport of marl up the River Dee, even as far as the Glenkins. Marl was discovered in abundance in and about the loch, and was formerly in great demand by agriculturists for fertilising their land, instead of lime. There are several islands, wooded with poplars, willows, alders, etc., which add to the picturesque appearance of the loch. An unpleasing feature is that the sewage of the town is drained into the loch, which, although about 105 acres in extent, is very shallow except at the sites of the old marl-pits, so that in hot, dry summers the residents of the town are inconvenienced by unpleasant odours and the risk of disease. The water at the south end is fairly clear and bright, but at the north end it is somewhat turbid and dead-looking, which is probably the result of the drainage from the town. The vegetation also has doubtless been affected thereby, for the semi-aquatic flora is composed of a large number of species, most of which grow in great luxuriance (figs. 54–56), whilst the submerged aquatics. although extremely abundant, are restricted in variety, possibly because the abnormal abundance of food-salts in the water, combined with the general shallowness of the loch. has favoured the excessive increase of a few species to the exclusion of others. I have, in fact, seen few lakes with such exuberant vegetation. The margin is frequently marshy and overgrown with a dense growth of reed or sedge. particularly in the south portion of the loch (figs. 55 and 56). At other places, especially at the northern end, the flat shore is either stony or of muddy sand, and nearly everywhere such shores are covered near the water with Cladophora flavescens, mixed with Œdogonium, Spirogyra, etc., and the same species float on the surface of the loch, occupying large areas in sheltered bays. Such floating Algæ are a constant feature in lowland lochs where the water is polluted with sewage. Many submersed plants had a deposit of calcium carbonate upon their leaves, particularly Myriophyllum spicatum. Reference has already been made to the large quantities of the fresh-water mussel found in various parts of this loch (p. 116). The roots and rhizomes of numerous plants, especially Glyceria aquatica, were frequently found covered with the young of this mollusc. The shallower portions at the south end of the loch are being rapidly encroached upon by the marsh vegetation, if one may judge by the wide area of bog, which, in turn, is being converted into meadow-land by the accumulation of the remains of plants that grow there. It would be very instructive to have a series of exact measurements from various lochs, extending over a number of years, in order to show the rate of encroachment upon the water, together with the rate of conversion of the bog behind into *terra firma*. The submerged plants of this loch are as follows:—Littorella lacustris, forming a bottom carpet in shallow places as usual; Callitriche autumnalis, covering large areas of the bottom; Potamogeton Friesii in vast quantity, some parts of the loch being choked with it; Myriophyllum spicatum, Potamogeton prælongus, and Nymphæa lutea were all very abundant, as well as the Algæ previously mentioned; Potamogeton lucens was less abundant, while P. natans, Castalia speciosa, and Ranunculus aquatilis were scarce. The littoral flora is more varied, and is composed of—Phragmites communis, Equisetum limosum, Glyceria aquatica (fig. 54), Typha latifolia, Carex rostrata, C. Goodenovii, Phalaris arundinacea, Menyanthes trifoliata, Polygonium amphibium, Heleocharis palustris, Deschampsia cæspitosa, Juncus lamprocarpus, J. effusus, Sparganium ramosum, all of which form more or less pure associations on many parts of the shore. In other places the bog is covered with an association in which any of the above may occur, more or less, as subordinate members, mixed with some of the following:—Carex acutiformis, Bidens cernua, Rumex Hydrolapathum, Cicuta virosa (fig. 56), Œnanthe crocata, Carum verticillatum, Apium nodiflorum, Radicula palustris, R. pinnata, Valeriana officinalis, Senecio aquaticus, Plantago lanceolata, Ranunculus Lingua (fig. 55), R. Flammula, Stellaria palustris, Myosotis palustris, Comarum palustre, Caltha palustris, Mentha sativa, M. aquatica, Equisetum palustre, Spiræa Ulmaria, Galium palustre, etc. [Carex disticha and C. teretiuscula occur in marshy ground to the south of the loch.—J. M'A.] Figs. 53 to 56 represent some of the features of this loch.

Auchenreoch Loch is 6 miles north of Dalbeattie, at an elevation of 345 feet above sea level, and it is surrounded by agricultural land. It is about a mile long, and varies in width from 600 yards at the south-west end to 100 yards at the north-east end, the greatest depth being 34 feet. The water is clear, and not peaty. The main road from Dumfries to Castle-Douglas adjoins the east shore of the loch throughout its length. At the north-east end there are associations of Scirpus lacustris standing out in the loch; nearer the shore a large area is covered with Phragmites communis, behind which there is a marsh, with the usual plants. These conditions extend for some distance down the loch towards the south-west end. At other places there is a narrow strip of stony shore, with meadow beyond, or there is scarcely any shore, grass-land coming down quite to the water.

Milton Loch is situated about a mile east of the last mentioned, at an elevation of 410 feet above sea level. It is over a mile long by ½ mile wide, and has a maximum depth of 15 feet. The outline of the loch is very irregular, and it is surrounded by agricultural land. The water is clear, and not peaty. The shores are flat and stony, and merge imperceptibly into meadow or arable land, except where bordered by trees or public roads. There are no associations of marsh plants entering the loch; such as occur are merely a few species as stragglers over the stony shore, Alisma ranunculoides being one of the most abundant. Chara fragilis, var. delicatula, and Chara aspera, var. subinermis, must be very abundant, as considerable quantities of both species were washed up on the shore.

Lochrutton Loch is situated at an elevation of 305 feet above sea level, 3 miles east of Loch Milton. It is a little smaller than that loch, but has a maximum depth of 58 feet. This loch is the reservoir for the water supply of Dumfries, and the non-peaty water is clear. An extensive marsh at the south end, which has been shut off from the loch by a dam, is overgrown with common plants, the chief of which are Scirpus lacustris, Phragmites communis, Phalaris arundinacea, Spiræa Ulmaria, Carex rostrata, Alisma Plantago, and in the water, Potamogeton natans and P. heterophyllus. The shores of the loch are mostly stony, and it is surrounded by cultivated land. The flora of the littoral zone is scanty, and presents nothing of particular interest (fig. 57).

The three last-mentioned lochs occupy somewhat bleak, wind-exposed situations in an area of active agriculture, and the scenery around is tame and uninteresting. I am unable to give a full account of the submerged flora of any of these lochs, because during the period of my visit the continuous storms of wind made the use of a boat for my purpose impossible. From an examination of the refuse washed upon the shores, I imagine the aquatic flora is of the ordinary type, and not particularly abundant. The chief plants more or less common to these three lochs, so far as I could find, are as follows:—Littorella lacustris, Chara aspera, var. subinermis, C. fragilis, var. delicatula, Potamogeton natans, P. lucens, P. heterophyllus, P. crispus, Sparganium natans, Ranunculus peltatus, Fontinalis antipyretica, Scirpus lacustris, Phragmites communis, Equisetum limosum, Heleocharis palustris, Sparganium simplex, Carex rostrata, C. Goodenovii, Phalaris arundinacea, Juncus acutiflorus, Spiræa Ulmaria, Alisma Plantago, A. ranunculoides, Ranunculus Flammula, R. Lenormandi, Myosotis palustris, Mentha sativa, Caltha palustris, Lythrum Salicaria, etc.

Lochaber Loch is picturesquely situated, 8 miles north-east from Dalbeattie. This loch, which is 298 feet above sea level, has a somewhat triangular outline; it is ½ mile long by ¼ mile wide, and has a maximum depth of 55 feet. It is surrounded by low hills, the lower slopes of which are wooded, chiefly with coniferous trees, to the water's edge (fig. 58), excepting on the west where the country is open and agricultural land prevails. The water is slightly peaty, and the marginal flora is poor in variety. No boat being available, I am unable to indicate the bottom flora. At the south-east end there are associations of Scirpus lacustris, Equisetum limosum, and Carex rostrata, none of which grows so tall and luxuriant as might be expected from the lowland situation. This is probably the result of wind, combined with a poor supply of food-salts. At the west side, where the shore is boggy, there are associations of Phragmites communis, but the specimens are dwarfed; also of Carex rostrata, Equisetum limosum, Castalia speciosa, and Menyanthes trifoliata; otherwise the somewhat flat and stony shores are either bare of vegetation, or sparsely clothed with a few common plants. Lobelia Dortmanna occurs abundantly here and there in the marginal zone, along with Littorella lacustris, but other submerged aquatics appear to be scarce.

Auchenhill Loch, which is 4 miles south of Dalbeattie, is the smallest of a group of four lochs. It is about ¼ mile long by 100 yards wide, and is a typical lowland pool, situated amidst pleasant pastoral scenery. There are no trees at its margin, but it is more or less surrounded by a zone of Phragmites communis, behind which there is a border of marsh, overgrown with plants common to such a habitat, and merging imperceptibly into meadow. In front of the Phragmites, a belt of Castalia speciosa almost encircles the loch. The water cannot be approached on account of the surrounding bog; and no boat being available, I am unable to give an account of the submerged flora.

Barean Loch is about ½ mile east of the last mentioned, but it is considerably larger, and has an irregular outline. Its water is rather peaty. It is picturesquely surrounded by low hills, some portions of which are cultivated, while the remainder consists either of moor or wood; the margin of the loch is also well wooded. It is more or less surrounded by a sedge or reed marsh, composed chiefly of the following species:—Scirpus lacustris, Phragmites communis, Equisetum limosum, and Carex rostrata. In the water beyond this zone, as well as mixed with it, Potamogeton natans, P. perfoliatus, Sparganium natans, Castalia speciosa, and Apium inundatum are the dominant plants. The last-mentioned species is particularly abundant, and grows luxuriantly in water 6 or 7 feet deep, reaching the surface from that depth, although not fruiting freely in such deep water. A number of common plants also occur, but less abundantly.

Clonyard Loch is ¼ mile south-west of the last mentioned. It is smaller than Barean Loch, but the features are somewhat similar. It is surrounded by a sedge or reed swamp, composed chiefly of Scirpus lacustris and Carex rostrata; there is also an association of Typha latifolia, as well as minor colonies of Phragmites communis and Equisetum limosum. In the water outside the swamp zone there is a broad belt of Castalia speciosa. Other abundant plants are Iris Pseud-acorus, Sparganium ramosum, and Lythrum Salicaria.

White Loch is the largest of this group, being about ½ mile long by ¼ mile broad. It is ½ mile south-east of the last mentioned, and the public road from Douglas Hall to Dalbeattie adjoins its western shore. The neighbouring district is a mixture of moor, cultivated land, and plantation, and the water is rather peaty. Where not marshy, the shores are sandy or stony, with a few syenitic rocks. It is little more than 100 feet above the level of the sea, which is about a mile distant; and although distinctly lowland in general aspect, yet some plants usually associated with peaty highland lochs flourish here alongside those commonly found in lowland lakes. This is probably because the loch has not been interfered with, whilst the surrounding moor has been brought under partial cultivation. Phragmites communis forms a belt around a considerable portion of the loch, especially on the east. On the west side there is a large association of Typha angustifolia, as well as smaller groups of the same at other parts of the loch. In the water, beyond the Phragmites and Typha, associations of Scirpus lacustris occur, whilst Carex rostrata and Equisetum limosum occupy other sites. Minor plants of the marsh formation are—Heleocharis multicaulis, Comarum palustre, Alisma Plantago, Juncus acutiflorus, J. lamprocarpus, J. effusus, Lythrum Salicaria, Ranunculus Flammula, Mentha sativa, Pedicularis palustris, Spiraea Ulmaria, Scutellaria galericulata, Hydrocotyle vulgaris, Hypnum cuspidatum, etc. The bottom is carpeted in many places with Littorella lacustris, Lobelia Dortmanna, Isoetes lacustris, Nitella opaca, and Fontinalis antipyretica, while the other submersed plants are Castalia speciosa, Potamogeton natans, P. pusillus, P. perfoliatus, P. lucens, P. crispus, P. rufescens, the last with floating coriaceous leaves, and Ranunculus Drouetii.

Photographs of these lochs could not be obtained, owing to the very unpropitious weather that occurred during the time allotted for their inspection.

At none of the lochs of this Area (V.) was there any particular abundance of Bryophytes; hence their general absence from the lists of plants.

III.—Area VI.

We now proceed to examine some of the lochs of Wigtownshire (p. 66), where both lowland and highland types may be found, although none of those that I have visited are at a greater elevation above sea level than 400 feet. Stormy weather considerably hindered work, so that during the time at my disposal I was unable to visit some of the lochs situated in outlying places, and difficult of access under any conditions. In particular, I regret having to omit those in the north of the county, within and without the Ayrshire border, because these are less likely to have undergone alteration by human agencies.

Black Loch is the smallest of a series of three, and is situated 5 miles north-west of Kirkcowan. It is about $\frac{1}{4}$ mile long, is surrounded by a treeless moor, and its water is rather peaty. The only strip of shore is at the east end; elsewhere a bank of peat separates the water from the moor. Rocks at the east end are overgrown with Grimmia apocarpa, Orthotrichum rupestre, Rhacomitrium lanuginosum, etc. Bryophytes are otherwise very scarce. The aquatic vegetation is chiefly at the west end of the loch, and bottom-carpeting plants such as Littorella lacustris are scarce. At the margin there are associations of the following species:—Phragmites communis, Scirpus lacustris, Equisetum limosum, Carex rostrata, C. filiformis, and Castalia speciosa, and the submerged aquatics are fairly represented.

Loch Heron is a somewhat rectangular sheet of water, nearly as large again as the last mentioned, and situated $\frac{1}{2}$ mile to the south-west of it. There is a plantation of conifers upon the south and east shores, otherwise it is surrounded by cultivated land or moor. The water is clear, and slightly peaty. The shores are stony, or in some places there is a peat bank entering the water without the intervention of a shore. There are associations of the following plants about the margins:—Phragmites communis, Carex rostrata, Scirpus lacustris, and a few sparse patches of Equisetum limosum. Littorella lacustris and Lobelia Dortmanna carpet the bottom in places, and there is a fair number of other submerged aquatics.

Loch Ronald is close to the last mentioned, and is about a mile long. There is a plantation of conifers on the east side, otherwise it is surrounded by agricultural land or moor. The water is very clear, and the shores are stony, flat, and, from a botanical aspect, almost featureless (fig. 59), much resembling Loch Ashie in Inverness-shire (*ante*, p. 1009, fig. 73). Here and there a bank of peat 8 or 10 feet high dips into the water without the intervention of a shore. There are two small associations of Equisetum limosum and one of Scirpus lacustris, all at the south-west end, and groups of Carex rostrata in the effluent. I was not able to obtain the use of a boat because it had been previously engaged, but a close examination of the barren shore for the remains of submersed plants suggested a scarcity of vegetation in the water.

The plants occurring at these lochs, but more particularly at Lochs Black and Heron, are as follows:—Littorella lacustris, Lobelia Dortmanna, Isoetes lacustris, Myriophyllum alterniflorum, Juncus fluitans, Scirpus fluitans, Potamogeton polygonifolius, P. lucens, P. rufescens, P. pusillus, P. obtusifolius, Fontinalis antipyretica, F. squamosa, Castalia speciosa, Sparganium natans, Scirpus lacustris, Phragmites communis, Equisetum limosum, Heleocharis palustris, Carex rostrata, C. filiformis, C. flava, var. lepidocarpa, Juncus lamprocarpus, J. acutiflorus, J. effusus, Ranunculus Flammula, Hydrocotyle vulgaris, Eriophorum polystachion, Comarum palustre, Polygonum Hydropiper, Mentha sativa, and Senecio aquaticus. There are a few specimens of Lythrum Salicaria at Black Loch, but this species will probably not succeed in getting well established there.

Clugston Loch is a small sheet of water, 3 miles south of Kirkcowan, with slightly peaty water, and surrounded by moor. The shores are rocky or peaty, and beyond colonies of Carex Goodenovii, C. rostrata, and Equisetum limosum there are no large associations of semi-aquatic plants, although the following are more or less abundant:—Littorella lacustris, Lobelia Dortmanna, Juncus fluitans, Apium inundatum, Scirpus fluitans, Fontinalis antipyretica, Potamogeton polygonifolius, P. lucens, Castalia speciosa, Menyanthes trifoliata, Utricularia intermedia, Equisetum limosum, Carex rostrata, C. Goodenovii, C. flava, Juncus lamprocarpus, J. effusus, Caltha palustris, Viola palustris, Ranunculus Flammula, Polygonum Hydropiper, Hydrocotyle vulgaris, Lythrum Salicaria, Eriophorum polystachion, etc.

Loch Wayoch is the most northerly of a group of lochs situated on a dreary, boggy moor many miles in extent. The last-mentioned loch is, indeed, upon the same moor, but at its outskirts, where the ground is less boggy, whilst there the scenery is enlivened eastwards by the adjacent area of cultivation. An old resident informed me that during his life the view of the county beyond the moor (*i.e.* looking from Anabaglish southwards) had been considerably curtailed, owing to the gradual elevation of the intervening moss.* Exact measurements of such development over a long period would not be without interest.

This loch is 4 miles south-west of Kirkcowan, and is a somewhat circular pool, 200 yards across. There is no shore, the water being surrounded by deep bog, differing only from the moor in being more ready to engulf the unwary. I succeeded in getting within a few feet of the water, and was surprised to find it was beautifully clear, and apparently not peaty. Another interesting fact was the presence of an association of Typha latifolia, a plant usually associated with the evil-smelling mud of lowland lakes rather than with that of a lochan in the midst of a peat moor. Other uncommon members of the marginal flora were Cladium Mariscus and Hypericum elodes, while the more usual species, such as Carex rostrata, Juncus effusus, J. bufonius, Menyanthes trifoliata, Narthecium ossifragum, Eriophorum polystachion, Hydrocotyle vulgaris, etc., formed the bulk of the phanerogamic vegetation. The following Bryophytes were also abundant:—Sphagnum cuspidatum, var. falcatum, S. cymbifolium, S. subsecundum, Polytrichum commune, Aulacomnium palustre, Hypnum Schreberi, H. cupressiforme, var. ericetorum, Cephalozia Sphagni, etc. On the drier parts of the bog Calluna and Myrica have spread from the adjacent moor, where Cladonia uncialis occurs in extraordinary abundance. I was not able to discover what plants, if any, grew in the water.

Fell Loch is larger than Wayoch, and ½ mile south-east of it. The water is peaty, and the bottom is of peat. The chief plants are Lobelia Dortmanna, Castalia speciosa, Potamogeton polygonifolius, Juncus fluitans, Heleocharis multicaulis, Cladium Mariscus, Carex rostrata, Phragmites communis, Equisetum limosum, Menyanthes trifoliata, Hydrocotyle vulgaris, etc.

Black Loch is close to the last mentioned, and similar to it, but the water is not so peaty, and there is less vegetation. Cladium Mariscus and Carex filiformis are abundant, as well as other commoner plants.

Mochrum Loch is ½ mile south of the last mentioned, but is much larger, being about 1½ miles long by ⅓ mile broad, and the elevation above sea level is 248 feet. This loch is very shallow, the average depth being only 7 or 8 feet, with a maximum of 13 feet. The outline is irregular and there is very little shore, merely a narrow strip of rocks or stones intervening between the water and the moor or wood; neither are there any sandy bays, but occasionally there is a stretch of peaty shore. The north and north-east sides are wooded, chiefly with coniferous trees, and on the east there is some cultivated land, otherwise the surrounding district consists of spongy moor. There are numerous islands scattered over the loch, some of which are wooded, and these, with the plantation at the northern end, form a pleasing feature in the otherwise bare scenery. In many places the bottom is rocky, and at these areas there is no vegetation; but where sand or mud obtains, there is an abundance of plants. The water is scarcely peaty, and is so clear that the bottom can be seen through a depth of 7 feet, even in dull weather. This pellucidity, not only of Mochrum Loch but of neighbouring ones as well, is not easily explained, because, from their situation in the midst of a spongy peat moor, one would expect the water to be quite peaty. The chief feeder is the burn from the adjacent Castle Loch; and as no stream of considerable size enters either loch, presumably they are fed partly by springs, which may, of course, have no connection with the water of the moor. It is probable, however, that some constituent, such as an alkali of the underlying rock, may neutralise the peat extract, thus rendering the water clear; the presence of certain calciphilous plants, *e.g.* Eupatorium Cannabinum, suggests lime also. Geologists might find this matter of some interest. A narrow cylindrical form of the fresh-water sponge is very abundant at some parts of this loch, the dredge occasionally coming up loaded with it.

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* A wet moor, with much Sphagnum, etc., is frequently called a moss.

The plants that flourish here are as follows:—Littorella lacustris, from the margin to 8 feet deep; Subularia aquatica, from the margin to 6 feet deep; Elatine hexandra, in small patches, from 2 to 8 feet deep; Isoetes lacustris, from 6 to 10 feet deep; Callitriche hamulata, from 4 to 6 feet deep; Potamogeton pusillus, and a very slender variety of it, extremely abundant at from 4 to 10 feet deep; P. obtusifolius, P. crispus, P. perfoliatus, P. natans, Myriophyllum alterniflorum, Fontinalis antipyretica, and F. squamosa. All the foregoing were very plentiful, while the following were less so:—Lobelia Dortmanna, Chara fragilis, var. delicatula, Nitella translucens, Juncus fluitans, Utricularia intermedia, Ranunculus aquatilis, Castalia speciosa, Nymphæa lutea, and Sparganium minimum. The marginal flora was rather scanty: there were fairly large associations of Phragmites communis, Carex rostrata, and Equisetum limosum, while the other species were either in small groups or more or less scattered, the chief being—Cladium Mariscus, Phalaris arundinacea, Sparganium simplex, Carex filiformis, Ranunculus Flammula, Juncus lamprocarpus, J. acutiflorus, J. effusus, Caltha palustris, Heleocharis palustris, H. multicaulis, Menyanthes trifoliata, Comarum palustre, Lysimachia vulgaris, Œnanthe crocata, Lythrum Salicaria, Lycopus europæus, Spiræa Ulmaria, Schœnus nigricans, Radicula officinalis, Hydrocotyle vulgaris, Scutellaria galericulata, and Polygonum Hydropiper. Eupatorium cannabinum occurred chiefly at the islands, on some of which Osmunda regalis was abundant. Bryophytes on the shore, with the exception of Hypnum cupressiforme, which covers rocks, and Sphagnum sp. in peaty places, were not abundant.

Castle Loch is ½ mile west of the last mentioned, which it much resembles in size and general features. It is 16 feet higher than Mochrum Loch, into which its north-eastern effluent flows. There are a few trees at the north end and on one of the islands, which also has upon it the remains of a small castle. The surrounding country is bare, open moor. This loch is studded with numerous bare, rocky islands, the largest being occupied by hundreds of cormorants, which breed there. The shores are rocky or stony, and the bottom is rocky nearly everywhere. The water is clear, like that of Mochrum Loch, and the average depth is from 6 to 8 feet, with a maximum of 11 feet. I dredged a dozen or more of the less rocky places and examined many other parts of the bottom, but could obtain no plants from the water save Fontinalis antipyretica and F. squamosa, which abound on the rocks. The bottom appears to be quite destitute of plants, excepting the two species just enumerated. This is remarkable, especially when the adjoining Mochrum Loch has such an abundant aquatic flora. Mr David M'Dowall, the keeper, informed me that he had never seen any plants upon the net when netting this loch. The water was remarkably free of plankton organisms, the tow-net gathering extremely little (end of August), but Mr M'Dowall told me that in early summer the water is thick and green with some organism that dies away towards the end of July. Perhaps the presence of this organism in the spring accounts for the absence of plants in the water. The scanty vegetation of the rocky shores was of no particular interest, being similar to that of Mochrum Loch, but less abundant. Lythrum Salicaria and Phalaris arundinacea were the most plentiful species. Fig. 60 illustrates this loch, with Mochrum Loch in the distance.

On Anabaglish Moss, to the north-west of Castle Loch, there are a number of small lochans of some interest because of the abundance of their vegetation, which includes some unusual species. Figs. 61 to 64 illustrate four of these tarns; the legends appended to the illustrations afford sufficient description.

[**Monreith Lake**, near Port William, is entirely surrounded by wood affording shelter to many rare species of water-fowl. In addition to the usual marsh and aquatic plants, which grow here very luxuriantly, this lake is becoming choked up with Anacharis Alsinastrum.—J. M'A.]

[**Dowalton Loch**, near Sorbie, was once an extensive sheet of water, but about sixty years ago it was almost emptied by cutting a deep outlet at its eastern end. Since then it has become overgrown with a dense growth of marsh plants, but cannot yet be said to be of much use agriculturally.—J. M'A.]

[**South of Whithorn** are numerous small lochs, becoming gradually overgrown with vegetation, amongst which several uncommon species of Carex may be found. Further south, and to the west of the Isle of Whithorn, there are several small lochs, in which grows the beautiful Chara polyacantha.—J. M'A.]

Barhapple Loch is 4 miles east of Glenluce, on an extension of the same moor as Castle Loch, from which it is distant also about 4 miles. It is a circular loch, about ¼ mile across, with dirty, peaty water. The north side is bordered by a dense association of Phragmites communis (fig. 65), whilst the same plant occurs scattered over the peaty and muddy south shore. On the west side there is a considerable extent of marsh, dominated by Carex rostrata, C. filiformis, etc. On the east the shore is peaty or gravelly, and is bordered by a bank of peat from 4 to 6 feet high. Large tussocks of Molinia cærulea extend over the peaty portion of this shore, but where gravelly it is encroached upon by large tussocks of Juncus effusus (fig. 66). Drainage from the farm on the south appears to gain access to the loch, and the exposed mud on that side is very foul, large patches of it being coloured red by Porphyridium cruentum. Juncus supinus, var. subverticillatus, with all the flowers viviparous, was very abundant on this mud, growing in large, flat tussocks. At the same place a very robust form of Peplis Portula, growing in prostrate patches, was plentiful (p. 75). On peaty portions of the east shore a short, erect, cæspitose form of Juncus supinus was common, and dwarf prostrate forms of Juncus bufonius were also abundant at the same place. There were very few mosses and no hepatics about the shores of this loch. No boat being available, the bottom could not be examined, but, so far as I could tell, submerged plants were scarce. Besides the above mentioned, the following species were observed here :—Littorella lacustris, Callitriche hamulata, Comarum palustre, Montia fontana, Mentha aquatica, M. sativa, Spiræa Ulmaria, Juncus lamprocarpus, J. acutiflorus, Ranunculus Flammula, R. hederaceus, Myosotis palustris, Hydrocotyle vulgaris, Viola palustris, Galium palustre, Veronica scutellata, and Alisma Plantago.

Loch Dernaglar, ½ mile south of the last mentioned, is somewhat circular in outline, and about ⅓ mile across. The moor around is flat and treeless, and the water is peaty. Banks of peat usually separate the water from the moor, but occasionally the shore is stony, or is formed of flat rock, this being particularly the case on the east side, which consequently is rather bare of littoral vegetation. The western margin is marshy, especially near the affluent (fig. 67), and supports a considerable vegetation, associations of Scirpus lacustris, Equisetum limosum, Phragmites communis, Carex rostrata, C. filiformis, and C. Goodenovii being dominant. Juncus lamprocarpus and J. acutiflorus grow together in abundance. Heleocharis multicaulis was common in water about a foot deep, many of its leaves floating on the surface, whilst the flowering stems were erect (fig. 68); viviparous forms of it were also plentiful. Pilularia globulifera was extremely abundant in shallow parts on the eastern side (fig. 69). The other plants observed at this loch were—Littorella lacustris, Lobelia Dortmanna, Subularia aquatica, Isoetes lacustris, Juncus fluitans, Myriophyllum alterniflorum, Chara fragilis, var. delicatula, Castalia speciosa (fig. 67), Potamogeton polygonifolius, P. natans, P. rufescens, P. lucens, Sparganium natans, Menyanthes trifoliata, Heleocharis palustris, Juncus effusus, Eriophorum polystachion, Ranunculus Flammula, Carex flava, var. minor, Hydrocotyle vulgaris, etc.

Whitefield Loch is 3 miles south-east of Glenluce, at an elevation of 191 feet above sea level. It has an angular outline, is about ½ mile long by ¼ mile wide, and is a good deal enclosed by trees with cultivated land or moor beyond. The water, which has a maximum depth of 14 feet, is slightly peaty, the shores are stony, and for the greater part bare of vegetation. The most noticeable feature of the shore flora is the abundance of Lythrum Salicaria. Besides a number of plants usual to the district, there is nothing here of particular interest.

Barlockhart Loch is a small circular pool, with non-peaty water, about a mile south-east of Glenluce. It is surrounded, excepting on the west, by low hills, the land being either pasture or arable. This loch is enclosed by a zone of Phragmites communis, beyond which, in the water, there is an association of Castalia speciosa and Nymphæa lutea also extending around the loch; but at the east end Equisetum limosum is interposed outside the Phragmites. Behind the last mentioned there is a strip of marsh with a number of the usual bog plants, as well as Salix aurita and Alnus glutinosa in places (fig. 70). A curious floating form of Hydrocotyle vulgaris occurred here (p. 77). Dwarf forms of Potamogeton obtusifolius in shallow water (p. 84), as well as the normal form in deeper water, were abundant.

The plants more or less common to this and the last-mentioned loch are as follows:—Littorella lacustris, Lobelia Dortmanna, Elatine hexandra, Nitella opaca, Chara fragilis, var. delicatula, Juncus fluitans, Myriophyllum alterniflorum, Apium inundatum, Fontinalis antipyretica, Callitriche stagnalis, aquatic and terrestrial forms; C. hamulata, Ranunculus Drouetii, Potamogeton natans, P. polygonifolius, P. obtusifolius, P. rufescens, P. Zizii, P. crispus, P. lucens, Castalia speciosa, Nymphæa lutea, Equisetum limosum, Phragmites communis, Sparganium natans, S. simplex, S. ramosum, Carex rostrata, C. filiformis, C. Goodenovii, C. flava, Polygonum amphibium, P. aviculare, Iris Pseud-acorus, Alisma Plantago, A. ranunculoides, Juncus acutiflorus, J. lamprocarpus, J. effusus, J. bufonius, J. conglomeratus, Comarum palustre, Ranunculus Flammula, Mentha aquatica, M. sativa, M. arvensis, Lythrum Salicaria, Myosotis palustris, Triglochin palustre, Epilobium palustre, Senecio aquaticus, Caltha palustris, Viola palustris, Veronica Beccabunga, Pedicularis palustris, P. sylvatica, Galium palustre, Carum verticillatum, Eriophorum polystachion, Hydrocotyle vulgaris, Stellaria uliginosa, Gnaphalium uliginosum, Sphagnum sp., and a few of the common marsh mosses.

White Loch is about 1 mile long by $\frac{1}{3}$ mile broad, with a maximum depth of 38 feet, and is one of the largest of a group situated about 3 miles east of Stranraer. This and the adjoining Black Loch are within the private grounds of Castle-Kennedy, the seat of the Earl of Stair, and are ornamental waters to Lochinch Castle. Although left as far as possible in a natural condition, these lakes are surrounded by lawns or meadows, which are furnished with groups of decorative trees; there are also wooded islands (figs. 71 and 72). There is no extent of shore anywhere about White Loch, neither is there any considerable development of marsh vegetation, but here and there narrow zones of marsh plants, 1 to 10 feet wide, intervene between the water and the grassy banks. The water, which has the same elevation above sea level as that of Black Loch, viz. 54 feet, is not peaty, but is so turbid and greenish-coloured that the bottom cannot be seen at a greater depth than 18 inches when looking over the side of a boat (*i.e.* in August). Plankton organisms are the cause of this turbidity, more especially the diatom Melosira granulata. There is neither affluent nor effluent to this loch save a shallow boat-canal connecting it with the adjoining Black Loch, the water of which is dark and peaty (presumably these facts guided the nomenclator of the lochs). The water is therefore more or less stagnant, a condition favouring the increase of certain plankton organisms. A feature of both this and Black Loch is the narrow border of Heleocharis palustris that prevails nearly everywhere, growing luxuriantly to a height of 3 feet, with very large inflorescences. With these, Radicula palustris, Myosotis palustris, Polygonum Hydropiper, P. Persicaria, P. amphibium, Phalaris arundinacea (fig. 71), Mentha aquatica, Juncus acutiflorus, Caltha palustris, and Ranunculus Flammula are the chief plants of the margin. Elatine hexandra grows exposed upon the shore, also in the water to a depth of 2 feet. Myriophyllum alterniflorum abounds to a depth of 6 or 7 feet; M. spicatum is abundant from 4 to 7 feet deep. Chara fragilis, var. delicatula, occurs sparingly from the margin to a depth of 6 feet. The following species of Potamogeton are all abundant, especially at the north-west end:—P. crispus, a beautiful form, with broad leaves, having a wide red midrib; the same form is also found in other lochs of this neighbourhood; P. Zizii, P. perfoliatus, P. prælongus, P. obtusifolius, P. pusillus, and a very large form of P. lucens. Callitriche autumnalis and Ranunculus peltatus occur sparingly. Bryophytes are scarce.

Black Loch, as already explained, adjoins the last mentioned. It is about 1⅓ miles long, and has a maximum breadth of ⅓ mile, but it narrows considerably towards the north-west end. The surroundings are similar to those of White Loch, but the water, which has a maximum depth of 50 feet, is brown and peaty; and although plankton organisms abound, the bottom can be seen to a depth of 3 feet when looking over the side of a boat. The shore is similar to that of White Loch, but the littoral flora is more varied. Usually water from 7 to 10 feet deep, or even deeper, occurs within a few feet of the shore. To a depth of about 7 feet a few of the usual submersed plants may be gathered, but they are by no means abundant as the bottom is generally stony. At greater depths than 7 feet no living plants can be found, but an abundance of dead vegetable remains, as at other shallow peaty lochs with no current to scour them. Cladophora glomerata covers stones abundantly from 2 to 7 feet deep. Fontinalis antipyretica occurs sparingly in similar positions. Myriophyllum alterniflorum grows from the margin to 7 feet deep, but is not very abundant. Littorella lacustris is found in places about the shores, but appears to be neither general nor plentiful, nor does it enter the water beyond a depth of a few inches, probably because of the constancy of the water level. Nymphæa lutea is abundant, and Potamogeton Zizii is scarce. No other submersed plants were observed in the main body of the loch. At the north-west end there is a somewhat circular basin, connected with the loch by a narrow channel. This is almost surrounded, excepting on the south-west side, by a narrow border of Phragmites communis, Typha latifolia, and Scirpus lacustris, whilst the surface is largely overgrown with Nymphæa lutea. On the south-west side of this basin there are small associations of marsh plants, composed chiefly of Carex rostrata, Heleocharis palustris, Lythrum Salicaria (fig. 74), Spiræa Ulmaria, and the recently mentioned species as well. At the south-east end of the loch there is a marsh, with the usual common plants (fig. 72). The most important plants about the shores of this loch are as follows:—Scirpus lacustris, Equisetum limosum, Glyceria fluitans, Heleocharis palustris, Phragmites communis, Typha latifolia (figs. 73, 74), Carex rostrata, Lythrum Salicaria, Juncus acutiflorus, J. effusus, Phalaris arundinacea, Spiræa Ulmaria, Œnanthe crocata, Deschampsia cæspitosa, Mentha aquatica, etc.

In the canal between the two lochs, Littorella lacustris, Alisma ranunculoides, Potamogeton Zizii, Myriophyllum alterniflorum, Callitriche autumnalis, and C. vernalis are the dominant species. Bryophytes are everywhere scarce.

Cults Loch is ½ mile east of the last mentioned. It is a small, somewhat circular loch, with non-peaty water, surrounded by meadow-land. This loch has no visible effluent, and near its centre the remains of a lake dwelling or crannog are to be seen. At the north-west and south-east sides there are small bogs; at other places a narrow zone of marsh, chiefly occupied by Juncus effusus, intervenes between the water and the pasture (fig. 75). No other features of interest were noticed here beyond a number of plants which need not be especially enumerated.

Loch Magillie is about a mile south-west of White Loch. It is a small oval lake 43 feet above sea level, having clear, non-peaty water, and no visible affluent or effluent. This loch is situated in a hollow, and the meadow-land, which surrounds it on three sides, runs down almost to the water's edge, a narrow strip of stony shore intervening. The shore is chiefly occupied by Juncus effusus, with which a few other plants are mingled, but there is no marsh. At the south-west side there is a plantation between the water and the adjacent road. The average depth is from 6 to 8 feet, and the floor of the loch is almost entirely covered with vegetation. Littorella lacustris carpets the bottom to a depth of 3 feet, and, creeping up the shore, mingles with the grass of the meadow. Lobelia Dortmanna is abundant to a depth of 5 feet, whence long peduncles elevate the flowers above the surface. Isoetes lacustris is abundant from 4 to 8 feet deep. Elatine hexandra occurs in patches very plentifully from the margin to 6 or 7 feet deep, and also on the shore (p. 74). Nitella opaca is very abundant from 4 to 9 feet deep. Fontinalis antipyretica and Potamogeton obtusifolius are scarce. Besides the above there are a few of the usual plants.

Soulseat Loch, which has a very irregular outline, is close to the above.

but is not visibly connected with it. It is 39 feet above sea level, is about ½ mile long and ¼ mile broad, with a maximum depth of 42 feet. The surrounding features are similar to those of Loch Magillie, as also is the margin. The west shore has a zone of Heleocharis palustris, as at White Loch, behind which, in some places, there is a narrow strip of marsh with the usual variety of plants. At other parts a narrow border of stones intervenes between the water and the meadow, this shore, as at Loch Magillie, being occupied by Juncus effusus. Nowhere is there any broad zone of marsh. The stones from the margin to a depth of from 2 to 3 feet are often thickly overgrown with Cladophora canaliculata, etc. A marked feature of this loch is the vast quantity of plankton organisms, which render the water quite turbid; in addition to which, there are such enormous numbers of Glœotrichia Pisum that in some parts the water resembles pale green paint. No doubt the turbidity of the water of this loch accounts in some measure for the poor bottom flora. The Rev. Mr Paton, whose manse is pleasantly situated on a peninsula jutting into the loch, informed me that in the winter the turbidity disappears, and then it is possible to see the bottom to a depth of 6 feet. Obviously the clearness of the water in winter has no effect upon the extension of a bottom flora of Phanerogams. No plants occur at a greater depth than about 6 feet, because in deeper water there is a deposit of vegetable detritus lying upon mud. Ranunculus circinatus and Callitriche autumnalis are the only dominant submerged Phanerogams, and both are extremely abundant. Potamogeton perfoliatus abounds in a few spots; Littorella lacustris and Nitella opaca occur, but not plentifully. These few species were the only submerged plants I could find. The marginal flora beyond what has been mentioned is of little interest.

There are three small lochs lying close to the railway, about a mile west of Castle-Kennedy station. The easternmost one was dry at the time of my visit, the site being covered with Juncus effusus and other marsh plants. The others are entirely overgrown with aquatic vegetation, and are so surrounded with extensive marsh that the water cannot be approached. No boat being available, I am unable to give a proper account of their floras, but some of the features are illustrated in figs. 76 to 78.

The plants observed at the lochs described after Black Loch, but not hitherto mentioned, as they form no prominent features at these lochs, are as follows:—Iris Pseud-acorus, Carex rostrata, Glyceria fluitans, Sparganium ramosum, Phalaris arundinacea, Comarum palustre, Juncus effusus, Mentha sativa, Œnanthe crocata, Ranunculus Flammula, Polygonum amphibium, Caltha palustris, Radicula officinalis, Bidens cernua, Hydrocotyle vulgaris, Hypericum elodes, Galium palustre, Spiræa Ulmaria, Peplis Portula, Callitriche stagnalis, Myosotis palustris, Equisetum palustre, etc., and a few common mosses.

[**The lake** at Lochnaw Castle partakes of much the same characteristics as Monreith Lake (p. 140), being also surrounded with wood. Carex pendula grows upon its shores.—J. M'A.]

There are some pools situated upon the Sands of Luce. Thinking, from the nature of the surroundings, that they might afford something of interest, I was disappointed to find they had dried up. Fig. 79 illustrates the site of one of these pools, the appended legend being a sufficient description. These sands extend about 6 miles along the coast, and reach inland about a mile and a half. The dunes, however, are nowhere very large; they begin quite abruptly just above high-water mark, and are immediately covered with Ammophila arundinacea (fig. 80), which binds the otherwise shifting sand. The highest dunes are at some distance from the sea; these also are capped with Ammophila, but are otherwise almost bare of vegetation. Usually, however, the dunes are quite stunted, and there is more vegetation (fig 81), or the ground is more or less flat and moor-like, with a complete plant-covering. The dominant plants are—Ammophila arundinacea, Carex arenaria, Salix repens, Hylocomium triquetum, Rhacomitrium canescens and its variety ericoides, Calluna vulgaris, and Pteris aquilina. These plants frequently form pure associations, or they may be more or less mixed. Occasionally there is a grassy sward, but, being closely cropped by rabbits, the species could not be readily identified. Near the sea a number of the usual halophilous herbs, such as Salsola Kali, Eryngium maritinum, Arenaria peploides, etc., occur scattered over the sand. About Low Torrs, and also at Glenluce, there are extensive salt-marshes with the usual vegetation, amongst which Ruppia rostellata, Scirpus maritimus, and Juncus maritimus (fig. 82) are particularly abundant.

IV.—Area VII.

The examination of the lochs of Fife and Kinross (p. 67) may begin at Lindores Loch in the neighbourhood of Newburgh; and after visiting others in the same district we go to Tents Muir, and thence to Kilconquhar Loch near Elie. From there we travel westwards, following a zigzag route, by way of Clatto Reservoir, Carriston Reservoir, Loch Gelly, Burntisland Reservoir, Loch Fitty, and others, to the lochs situated on the Cleish and Lomond Hills, and thence to Loch Leven. Finally, on an ebb tide and with a westerly wind, we sail out of Anstruther harbour for the Isle of May.

Lindores Loch is situated 2 miles south-east from Newburgh, amidst a beautifully wooded and agricultural country, where hill and dale follow one another in quick succession. The loch is about ¾ mile long and ¼ mile broad, its surface being 222 feet above sea level. Its water, which has a maximum depth of 10 feet, is not peaty, but turbid and dead-looking. In many places there is deep, black, fetid mud upon which submersed aquatic plants do not seem to flourish well. In several places, but particularly at the north-west and south-east ends, as well as on the east side, there are large associations of marsh plants. At other places there is a narrow strip of stony or sandy-muddy shore merging into meadow-land. Such shores are usually more or less overgrown with Juncus acutiflorus; this is particularly the case on the west side. Along a considerable portion of the east side runs the public road from Newburgh to Kirkcaldy. This is shut off from the loch by a wall which usually enters the water, and no marsh plants occur there. At other places on the east side there is a stony or sandy shore similar to that of the west side, but usually with less vegetation. In the middle of the loch there is an island formed by a muddy flat, and densely overgrown with Phragmites communis. Many submersed plants have a deposit of lime upon their leaves and stems, and, as is commonly the case with lochs of this nature, filamentous Algæ, particularly Cladophora flavescens, abound. The striking features of the vegetation of this loch are the large quantities of the following plants:—Typha angustifolia, Glyceria aquatica, Scirpus lacustris, Phragmites communis, Phalaris arundinacea, Polygonum amphibium, Nymphæa lutea, Ranunculus circinatus, R. peltatus, and Myriophyllum alterniflorum.

At the south-east end Nymphæa lutea and Polygonum amphibium cover the surface of the water. Nearer the land there are associations of the following:—Glyceria aquatica, Typha angustifolia, Phragmites communis, Iris Pseud-acorus, Heleocharis palustris, Equisetum limosum, and Carex rostrata. Between these associations, and mixed with them, are the following:—Littorella lacustris, Potamogeton natans, Sparganium simplex, Menyanthes trifoliata, Mentha sativa, Alisma Plantago, Caltha palustris, Radicula officinalis, Ranunculus Flammula, Carex disticha, Hydrocotyle vulgaris, Hypnum cuspidatum, etc. Upon the west side, skirting the shore, there are associations of Glyceria aquatica, Scirpus lacustris, and Polygonum amphibium, besides a number of other plants in less abundance. From the middle of the east shore a flat peninsula juts out into the loch. This is considerably overgrown with Typha angustifolia (fig. 85), Heleocharis palustris, Phalaris arundinacea, Spiræa Ulmaria, and, mixed with them, a variety of other plants. On drier ground, Agrostis vulgaris abounds, whilst the surface of the adjoining water is covered with Nymphæa lutea (fig 85) and Polygonum amphibium. The extensive area of marsh at the north-west end has a very luxuriant vegetation, Typha angustifolia, Glyceria aquatica, Polygonum amphibium, Equisetum limosum, and Carex rostrata being the dominant forms (figs. 83–84).

Besides the above mentioned, the following plants also occur here:—Callitriche autumnalis, Potamogeton filiformis, P. Zizii, P. pusillus, Sparganium ramosum, Comarum palustre, Callitriche stagnalis, Eriophorum polystachion, Epilobium palustre, E. tetragonum, E. hirsutum, Myosotis palustris, Heleocharis acicularis, Juncus bufonius and its var. fasciculatus, Carex flava, C. hirta, Scirpus setaceus, Mentha aquatica, M. arvensis, Ranunculus Flammula, Lycopus europæus, Lythrum Salicaria, Alisma ranunculoides, Hypnum fluitans, H. cuspidatum, and other common marsh mosses.

Black Loch is a small oval pool $\frac{1}{5}$ mile long, situated about a mile south-west of the last-mentioned loch, and surrounded by agricultural land. Excepting for a portion of the south shore, this loch is so entirely surrounded by marsh that the water cannot be approached. Its water is not peaty, but clear and bright, and is entirely encircled by a zone of Castalia speciosa and Nymphæa lutea, the latter being next the shore, which is the reverse of the order in which they usually grow (figs. 86 and 87). At the south side no other plants occur between these and the gravelly-muddy shore, but elsewhere there is a zone of Equisetum limosum between the Nymphæa lutea and the land. Here and there, all around the loch, there are associations of Glyceria aquatica on the shore side of the Equisetum. Upon both the east and west ends of the strip of gravelly shore on the south side, there is a large and pure association of Menyanthes trifoliata (fig. 86). In some places, particularly at the west end, where there is a large bog, the Equisetum limosum is followed by Carex rostrata, and that, in turn, by Juncus effusus on the drier ground. Besides the above, the following plants also occur at this loch:—Littorella lacustris, Myriophyllum alterniflorum, Ranunculus aquatilis, Utricularia vulgaris, Polygonum amphibium, Comarum palustre, Heleocharis palustris, Carex Goodenovii, C. disticha, Iris Pseud-acorus, Alisma Plantago, Caltha palustris, Mentha sativa, M. aquatica, Juncus acutiflorus, Ranunculus Flammula, Cardamine pratensis, Galium palustre, Hydrocotyle vulgaris, and a few common marsh mosses.

Lochmill Loch is beautifully situated amongst the hills, 2 miles south-west from Newburgh, which it supplies with water. It is about ⅓ mile long, and half that in width. Low hills of volcanic rock, with grassy or cultivated sides, and occasional plantations of coniferous and deciduous trees, surround it, excepting at the east end, which is more open. Although peat occurs on the higher hills immediately to the south and west, it is doubtful if any appreciable quantity of peaty water gains access to the loch. There is not much marshy ground, although near the effluent at the east end, as well as at other places here and there about the shore, small areas of marsh occur. Excepting for the marshy areas and a rocky part on the south-west, the shores consist of muddy gravel, and merge imperceptibly into the grassy banks. The water is clear, non-peaty, and apparently of a steely-gray colour, probably due to the copious deposit of black mud on the bottom, which arises from the rapid decomposition of a very luxuriant aquatic flora. Many of the submersed plants were heavily coated with a deposit of calcium carbonate. That beautiful species of the Polyzoa, Plumatella repens, was very abundant on sunken twigs, etc., and many of the submersed plants, particularly Littorella lacustris, were overgrown to an extraordinary degree with Diatomaceæ. On the north side there is a large association of Polygonum amphibium (fig. 88), which is frequently mixed with Potamogeton natans, and a belt of the latter extends along the outside of the Polygonum in deeper water. A similar phenomenon also occurs upon the south side, as well as a large and pure association of Potamogeton natans, which in this loch is of typical form, and perfectly distinct from any variety of P. polygonifolius. Potamogeton Zizii and a large form of P. lucens are both very abundant, and cover large areas of the bottom to a depth of 10 feet. Littorella lacustris is abundant upon the shores and in the water to a depth of 3 feet. Heleocharis acicularis frequently forms a sward upon the shore, in which condition it may be mistaken for a fine-leaved grass; it also grows to a depth of 3 feet.

Besides the above mentioned, the following plants are more or less abundant: — Chara aspera, C. hispida and its var. rudis, Callitriche autumnalis, Myriophyllum alterniflorum, M. spicatum, Ranunculus circinatus, R. peltatus, Potamogeton obtusifolius, P. pusillus, Castalia speciosa, Nymphæa lutea, Apium inundatum, Glyceria fluitans, Sparganium natans, Equisetum limosum, Heleocharis palustris, Sparganium simplex, S. ramosum, Carex rostrata, C. flava, Alisma Plantago, Glyceria aquatica, Callitriche stagnalis, Juncus acutiflorus, J. effusus, J. bufonius, Montia fontana, Mentha sativa, Gnaphalium uliginosum, Polygonum Hydropiper, P. Persicaria, Ranunculus Flammula, Caltha palustris, and a few of the ordinary marsh and rock mosses.

Morton Lochs, situated on Tents Muir, and of recent construction, are of considerable interest because of the rapid development of an extensive aquatic flora that has occurred there.

Mr James Morton Christie, the owner of the lochs, formed them in 1906 for fishing purposes by enclosing a natural depression of the land by means of a wide embankment of sand, and by diverting a burn to the site as a feeder. This moor (muir) is an extension of the sand dunes now nearly 3 miles to the east, and is mostly a sandy heath, some of the more favourable spots, however, being under cultivation. In the way indicated, two lochs were formed, having a general depth of from 4 to 8 feet. One of them is about ½ mile long and ¼ mile broad, whilst the other is about half that size; they are connected by a narrow passage through the embankment, which alone separates them. Although there was a thin covering of peat over the sand, still the water is not peaty, because the feeder originates in and passes through a cultivated and non-peaty district.

For the first two years no aquatic Phanerogams were noticeable in the lochs, but there was a great abundance of Algæ, chiefly Rhizoclonium hieroglyphicum, Spirogyræ, and Cladophoræ, which, becoming detached from the sides of the loch, where they chiefly originated, floated about in the water and bade fair to ruin the fishing. These Algæ are now kept down by spraying the sides of the loch with a solution of copper sulphate in the spring.

During the third summer a considerable growth of submersed Phanerogams appeared, but not in sufficient quantity to interfere with the fishing. By the fourth summer, however (*i.e.* in 1909), the plants had increased to such an extent that they would seriously impede the operations of the sportsman were they not subjected to frequent raids by the proprietor of the lochs.

At present there is no development of marsh vegetation at the margin of either loch, such plants being, in fact, practically absent, which is not surprising, in view of the applications of copper sulphate previously mentioned. In both lochs the dead Calluna lying at the bottom is covered with Cladophora, etc. In the smallest loch, which is the southernmost one, Myriophyllum spicatum occurs in extraordinary abundance; somewhat less plentiful are Potamogeton obtusifolius, P. pusillus, and P. crispus; and these four species may be said to fill the loch to the exclusion of other plants. In the largest loch Myriophyllum spicatum is not very abundant, but the three species of Potamogeton just mentioned are very plentiful, whilst P. polygonifolius, P. perfoliatus, and Myriophyllum alterniflorum occur, but are all scarce. Nitella opaca, Chara vulgaris and its var. papillata, C. contraria and its var. hispidula, C. fragilis and Callitriche hamulata, both with and without floating rosettes, are all frequent, the varieties of the two species of Chara being more abundant than the types. Juncus fluitans, Littorella lacustris, Ranunculus peltatus, R. Baudotii, R. Drouetii, and Hydrocotyle vulgaris occur sparingly, whilst Callitriche stagnalis is plentiful.

As may be imagined from the nature of the embankment, a deal of leakage takes place around these lochs, and a number of little pools have been formed by the accumulation of the water in hollow places, besides which, others have been intentionally made as nurseries for the young trout. Some of these pools are interesting because of the number of plant forms that grow in and around them. Two in particular exhibit a large number of variations in species of Juncus, chiefly of J. acutiflorus, J. supinus, and J. bufonius. Others have curious forms of Ranunculus Flammula, and at one the var. natans of *Persoon* is very abundant (p. 72). In other places Marchantia polymorpha, *L.*, covers considerable tracts of wet ground, producing its reproductive bodies, both asexual and sexual, in extraordinary abundance. On the sides of a drain 2 feet deep that had been cut in the sand only two years previously, Blasia pusilla, *L.*, was growing luxuriantly, as well as numerous commoner Bryophytes. The Blasia also occurs abundantly at some other places which are kept moist by the water escaping from the lochs; and on the sandy-peaty shores of some of the pools exposed in summer by the falling of the water level, Botrydium granulatum, *Grev.*, and Riccia crystallina, *L.*, were very abundant, R. glauca, *L.*, and Aneura pinguis, *Dum.*, were fairly common, whilst Riccia Lescuriana, *Aust.*, and Aneura latifrons, *Lindb.*, were scarce.

The advent of the lochs on the previously dry, sandy moor has wrought considerable changes in the flora of the immediate district even in this short time, and doubtless others will follow. Where the plants came from is an interesting problem, to which a satisfactory answer is not easily found, but in all probability seeds and spores have been brought to the lochs by water-birds migrating eastwards from the lochs of central and western Fife, where most of the plants, excepting the rare Hepaticæ, abound.

Kilconquhar Loch is situated about a mile north of Elie, at an elevation of 49 feet above sea level. It is a very shallow circular loch about ½ mile across, and is so completely surrounded with marsh and reed swamp that the water can only be approached at a few places, consequently there is no definite shore. The village of Kilconquhar is situated on the north side of the loch (fig. 92), and the gardens of the adjacent cottages run down to its margin. The ornamental grounds of Elie House, which are wooded or park-like, adjoin and beautify the south side (figs. 89 and 91). Upon the east and west sides the loch is surrounded by agricultural land. The bottom of the loch at the north and west sides consists of deep black mud, but at the south and east sides the bottom is less muddy, and in many places is formed of firm sand. From near the margin to some distance out the average depth of water is from 3 to 5 feet, but as the middle is approached the depth increases somewhat, never, however, exceeding 7 feet. The water is non-peaty and clear, but has a stagnant appearance, which may be described as dead in comparison with the sparkling water of a pellucid highland loch. It is probably rich in plant food-salts, and in consequence of such favourable chemical and physical conditions the whole of the bottom of this loch is more or less overgrown with plants. The marginal swamp vegetation (figs. 89 and 90) is chiefly composed of associations of the following species:—Scirpus lacustris, Equisetum limosum and its var. fluviatile, Phragmites communis, Heleocharis palustris, Carex rostrata (in some places a very robust form of this plant occurs with leaves 5 feet long), Hippuris vulgaris, Typha latifolia, Epilobium hirsutum, Menyanthes trifoliata, Sparganium ramosum, and Phalaris arundinacea. At the south-east side of the loch there is a large association of Polygonum amphibium, whose leaves and flowers cover a very considerable area of the water beyond the marsh (fig. 91). Outside this zone of Polygonum a wide space is occupied by associations of Potamogeton pusillus, P. filiformis, P. pectinatus, Zannichellia palustris, var. brachystemon, Myriophyllum spicatum, Callitriche autumnalis, etc. From the outer margin of this space Ranunculus circinatus reaches the surface even from a depth of 7 feet, and continues to the opposite side of the loch, but nearer the village this species thins out somewhat, and there, Ranunculus Baudotii becomes the dominant plant. The white flowers of these two species and the floating leaves of the latter entirely cover the surface of the water over a large area (fig. 92). Although these two species of Ranunculus were growing together very freely in some parts of the loch, no form was found that might be considered a hybrid between them.

Looking across the loch from the village to the south-east corner, the spectacle presented by the surface-flowering species was unique. The expanse of white Ranunculi, followed by the gorgeous pink of the Polygonum, backed by the dark foliage of the deciduous trees, to which a skirting of paler green was afforded by the marginal associations of Phragmites and Typha, and illuminated by the refulgence of a cloudless sky, gave such a combination of vivid colour contrasts, harmoniously pleasing to the eye, as can rarely be seen in this country.

All the plants mentioned as occurring between the associations of Polygonum and Ranunculus are also abundant at other parts of the loch. Zannichellia palustris, var. brachystemon, occurs in extraordinary quantity on the deep black mud at the west side, whilst Myriophyllum spicatum is so plentiful in some places, particularly on the east side, that the surface of the water appears crimson with its flowers. Callitriche autumnalis occurs chiefly in small patches a yard or less across, but in a few places considerable areas of the sandy bottom are covered with it. Lemna trisulca is extremely abundant in shallow water, especially at the north side near the village. Large masses of Cladophora flavescens and Enteromorpha intestinalis were floating about in many places; indeed, I have only seen such a prodigious quantity of the last mentioned at one other place in Scotland, namely, at Duddingston Loch, near Edinburgh. In some places a species of Nostoc was abundant, floating in masses amongst the vegetation of the margin. A single specimen of Hippuris vulgaris was gathered here, having the nodes in the form of a continuous spiral from base to apex. Considering the shallowness of the loch and the other apparently favourable conditions, it seems astonishing that the reeds which grow so luxuriantly at the margin, particularly Scirpus lacustris, Phragmites communis, and Equisetum limosum, have not overgrown it almost completely.

Besides those already mentioned, the following plants were plentiful at this loch:—Chara aspera and its var. capillata, Potamogeton crispus, P. perfoliatus, P. obtusifolius, Lemna minor, Caltha palustris, Sium angustifolium, Comarum palustre, Epilobium tetragonum, Mimulus Langsdorffii, Myosotis palustris, Veronica scutellata, Mentha aquatica, M. sativa, Equisetum arvense, E. palustre, Ranunculus Flammula, Juncus acutiflorus and J. effusus. There are a few common bog mosses, but such are not abundant, as favourable situations are scarce.

Halton Reservoir is a small, irregularly shaped sheet of water situated about 2 miles north of Largo. It has been formed by the widening of the natural gorge of the Halton Burn and by the construction of a dam at the lower end. At the time of my visit the water had fallen about 12 feet below the full water level, leaving upon the exposed mud the remains of a number of aquatic plants. Some of these were growing in terrestrial form upon the mud, *e.g.* Myriophyllum spicatum, Polygonum amphibium, Ranunculus peltatus, Potamogeton natans, Callitriche stagnalis, etc. In some places the mud was thickly covered with dead remains of Chara fragilis, which is extremely abundant there. A large quantity of the same species was still flourishing in the water, which under conditions of normal water level would be at a depth of about 14 feet. Gnaphalium uliginosum is very abundant, and forms a sward upon the sides near the full water level.

Except a few common marsh plants about the affluents at the west and north, nothing else of botanical interest was noticed here. When the water is low, the steep rocky or stony sides give this place the appearance of a flooded quarry, which indeed it is.

Clatto Reservoir is situated about 3 miles south of Springfield, at an elevation of over 500 feet above sea level, in an upland district of which Clatto Hill is the highest point. It is a narrow sheet of water about ¾ mile long, made by building a dam across the east end of the valley through which flows the Ceres Burn. The water is clear, and not peaty, and is bordered in many places by a zone of marsh, or a narrow strip of sandy-muddy or stony shore may intervene between the water and the grassy banks. Skirting a portion of both the north and south shores there are plantations of coniferous trees, otherwise the surrounding country is mostly of the agricultural type. At the east end, where the dam is, deep water occurs, and this part bears no plants, but at the shallow west end there is an extensive development of marsh. The vegetation of this marsh consists chiefly of the following species:—Juncus effusus, J. acutiflorus, Deschampsia cæspitosa, Spiræa Ulmaria, Carex Goodenovii, C. rostrata, Heleocharis palustris, Sparganium ramosum, Menyanthes trifoliata, and Comarum palustre. These species occur in definite associations in accordance with the amount of water, whilst the minor plants of this formation are—Cnicus palustris, Stachys palustris, Ranunculus Flammula, R. hederaceus, Caltha palustris, Callitriche stagnalis, Montia fontana, Hydrocotyle vulgaris, Galium palustre, Mentha sativa, M. aquatica, Radicula officinalis, Glyceria fluitans, and Veronica Beccabunga. In deeper water, beyond the associations above mentioned, a large area is occupied by Equisetum limosum, with which are mixed, here and there, small patches of Hippuris vulgaris. These advance into water 3 or 4 feet deep, and succeeding them there are associations of Ranunculus aquatilis, Sparganium natans, Potamogeton natans, P. pusillus, P. obtusifolius, and Myriophyllum spicatum, running out into water 7 or 8 feet deep.

The south shore has a border of marsh along a considerable portion of its length, chiefly composed of Juncus effusus, J. acutiflorus, Cnicus palustris, Deschampsia cæspitosa, Spiræa Ulmaria, Carex Goodenovii, C. rostrata, and Heleocharis palustris, the last being the most abundant, and occupying a zone from 10 to 20 feet wide outside the other species. In deeper water, beyond the zone of Heleocharis palustris, there are patches of the submersed plants mentioned above, Potamogeton natans and Myriophyllum spicatum being the most abundant. Here and there, where the border of marsh is absent, the shore is frequently carpeted with Littorella lacustris, whilst Heleocharis acicularis is scarce.

The north shore resembles that on the south, but vegetation is somewhat less abundant. In some places associations of Equisetum limosum extend into the water beyond the marginal zone of Heleocharis palustris.

At the south-east end, an arm to the reservoir has been formed by constructing a dam across an adjacent valley and excavating a connection. The flora of this arm or bay is similar to that of the main body of water. There is an extensive marsh on its west side, with vegetation similar to that existing at the west end of the main reservoir, excepting that Spiræa Ulmaria is conspicuous by its greater abundance and luxuriance, and that the var. fluviatile of Equisetum limosum is more abundant than the type.

Bryophytes are poorly represented by a few of the common marsh mosses. The Heleocharis palustris growing at this reservoir was much diseased by Claviceps nigricans, *Tul.* (*Sclerotium Eleocharidis*, *Thum.*), some of the inflorescences bearing 3 or 4 ergots ½ inch long. This fungus is one seldom met with in this country.

Carriston Reservoir is a sub-circular sheet of water, ¼ mile across, situated 2 miles north-east of Markinch in a rich agricultural district. It was formed by the construction of a long dam across a valley through which flowed a tributary of the River Leven. The water is clear, and not peaty. The dam occupies most of the west side, and there is not much shore on the south, as a bank, which is faced with stonework, frequently enters the water. On the north and east there is a flat, sandy or muddy shore, and the small amount of marsh vegetation about the loch occurs at this place. There is a mixed plantation and a few isolated trees on the north shore (fig. 93), otherwise there is no wood in the immediate vicinity of the water. Heleocharis acicularis forms a dense sward on parts of the sandy-muddy shore, covering it as grass does a meadow, and entering the water to a depth of 3 or 4 feet. I have not seen this plant so abundant anywhere else. On some parts of the exposed shore terrestrial forms of Myriophyllum spicatum were abundant. In one or two places Gnaphalium uliginosum and Juncus bufonius formed a dense sward. Heleocharis palustris is abundant near the winter water level, but the plants are dwarfed, being only 6 or 8 inches high, probably because they are left comparatively dry in summer, owing to the water receding from them. The tiny Ranunculus reptans is very abundant here, even more so than at Loch Leven, where it also occurs, the sandy shore in some places being covered with it (fig. 94). Water-fowl migrating eastwards from Loch Leven, and avoiding the Lomond Hills, would be likely to drop down at Carriston, which is only 10 miles distant, and probably by their agency several plants common at Loch Leven have been introduced to this reservoir.

Besides the above, the following plants also occur here:—Littorella lacustris, not abundant; Nitella opaca, Callitriche autumnalis, and Myriophyllum spicatum, all very abundant; Potamogeton pusillus, P. perfoliatus, and Polygonum amphibium, not abundant. All the following were comparatively scarce:—Carex rostrata, C. Goodenovii, C. disticha, C. flava. Caltha palustris, Mentha sativa, M. aquatica, Juncus acutiflorus, J. effusus. J. conglomeratus, Phalaris arundinacea, Spiræa Ulmaria, and Ranunculus Flammula. Bryophytes were very scarce.

Kinghorn Loch is a rectangular sheet of water about ⅓ mile across. situated a mile west of the village of Kinghorn, at an elevation of 204 feet above sea level. The water, which has a maximum depth of 38 feet, is not peaty, but turbid and dead-looking. The west shore, upon which there are a few willow trees, is flat and boggy, and its vegetation merges into that of the adjoining meadow, this being the only side of the loch where there is any development of marsh plants. A public road adjoining the south side is shut off from the loch by a wall and a row of bushes, below which a few marsh plants may be found, but there is practically no shore, except in a dry season when the water has fallen. The east shore is composed of dirty sand or gravel, with stretches of bare volcanic rocks. At the north side either meadow-land or a wall adjoins the water, without the intervention of a shore.

In early summer the water contains a vast quantity of Anabæna Flos-aquæ, var. circinalis, which so discolours the water in some parts, in accordance with the direction of the wind, that it has the appearance of pale green paint. A number of perch, which, I suppose, were killed by the Anabæna, were strewn about the shore. The exact action of this alga upon the fish is not known, but it is usually thought that it clogs the gills, although there may be poisonous properties as well, several species of Myxophyceæ being known to be baneful to horses and cattle that drink water containing them.

The west side of the loch is overgrown with an association of Polygonum amphibium, that extends from the marshy ground outwards until the water is 6 or 7 feet deep, which is an unusual depth for this plant to flourish in. On drier parts of the bog terrestrial forms of Ranunculus peltatus and R. Drouetii cover a considerable tract, mingling with the Polygonum on the one hand, and with the grass of the meadow on the other. I have not seen these plants growing in terrestrial form to such an extent elsewhere. The following marsh plants also occur, but more or less scattered, as there are no large associations; and it will be noticed that while a number of uncommon plants grow at this loch, some of the usual ones are absent:—Equisetum limosum and its var. fluviatile, Sparganium ramosum, Heleo-

charis palustris, Alisma Plantago, Glyceria fluitans, terrestrial form, Veronica Beccabunga, Mentha aquatica, Carex hirta, both tall and dwarf forms; Caltha palustris, Juncus effusus, J. glaucus, J. acutiflorus, Phalaris arundinacea, Apium inundatum, terrestrial form; A. nodiflorum, var. repens, Sium angustifolium, Cardamine pratensis, Ranunculus Flammula, R. sceleratus, Radicula palustris, Myosotis palustris, Equisetum arvense, both tall and dwarf forms, and Hypnum cuspidatum.

The submersed aquatic plants are uninteresting and comparatively scarce. Littorella lacustris is abundant, and in many places forms a sward on the shore when the water has fallen. Potamogeton crispus, as well as the f. serratus, *Huds.*, and Myriophyllum spicatum, are fairly abundant, although they do not appear to be thriving very well. Potamogeton pectinatus and Ranunculus peltatus are scarce. Enteromorpha intestinalis is scarce, whilst Cladophoræ abound. In the paucity of submerged plants this loch agrees with some others in which "water-bloom" occurs in early summer, and, excepting for the occurrence of this phenomenon, the loch would probably support a rich aquatic flora.

This loch was one of the first recorded stations for Potamogeton Zizii in Britain, the spot, indeed, where Mr Boswell (Syme) collected the specimens which he distributed under the name of "P. lucens with floating leaves," subsequently referred to P. Zizii. This plant, however, now appears to be extinct in the loch.

Loch Camilla is a small oval sheet of water about 4 miles east of Cowdenbeath. The water, which is not peaty, is rather turbid, and is surrounded by meadow-land which approaches almost to the margin of the water. The narrow shore on the east, south, and north is stony and bears but few plants, but at the west end there is a considerable development of marsh vegetation. A large association of Equisetum limosum, mixed here and there with patches of Hippuris vulgaris, stands out in the water. Nearer the land there is a large association of Carex rostrata, behind which there is a wide stretch of bog gradually merging into meadow, and this bog is covered with the following plants:—Menyanthes trifoliata, Heleocharis palustris, Radicula officinalis, Caltha palustris, Cardamine pratensis, Mentha sativa, Galium palustre, Myosotis palustris, Ranunculus Flammula, Alisma Plantago, Juncus effusus, J. glaucus, J. acutiflorus, Phalaris arundinacea, Deschampsia cæspitosa, Spiræa Ulmaria, Cnicus palustris, Pedicularis palustris, Comarum palustre, Carex flacca, C. Goodenovii, Angelica sylvestris, Veronica Beccabunga, Ranunculus hederaceus, and a curious semi-terrestrial form of R. peltatus, with purple blotches on the peltate leaves, which suggests a crossing with R. hederaceus. A number of Bryophytes are also abundant at this marsh, particularly Hypnum cuspidatum, Hylocomium squarrosum, Mnium rostratum, and Marchantia polymorpha. The following plants were abundant in the water:—Chara vulgaris, covering an extensive area of the bottom, and C. contraria. Littorella lacustris, Heleocharis acicularis, Potamogeton crispus, P. filiformis, P. pusillus, Myriophyllum spicatum, Callitriche autumnalis, Ranunculus peltatus, and near the margin a floating form of R. hederaceus. Possibly there are other species, but these are all I could discover without a boat.

Loch Gelly is an oval loch about ¾ mile long, situated at an elevation of 351 feet above sea level, 2 miles east of Cowdenbeath, and close to the village of Lochgelly. The loch is surrounded by low hills, which slope gently towards the water, except on the west side, where the country is quite open as far as Cowdenbeath, whilst the effluent passes through a depression of the ground at the east end. The district around is of the agricultural type, with a few acres of rough boggy pasture at the west end of the loch, which was probably a portion of its bottom at a former period. The margins of this shallow loch are so gently inclined, that only in a few places can a boat be brought within 20 feet of the shore because of the shallowness of the water. The sides at the north and east slope gently towards the loch, and are covered with a fine, close grass sward, about which there are a few large deciduous trees. This meadow-land gives place near the water's edge to a narrow shore of dirty sand or gravel, with a few larger stones, but, excepting some patches of Caltha palustris, Ranunculus Flammula, Littorella lacustris, etc., there is little vegetation on these shores. The west shores consist largely of a Phragmites swamp (fig. 95), behind which there is a marsh of varying width, which merges into the area of boggy pasture previously mentioned. Towards the north-west corner, however, about the affluent, the swamp is occupied by a considerable variety of plants an enumeration of which will be given presently. On the drier patches of this portion of the marsh there are bushes of Alnus glutinosa, Salix aurita, etc., and on the better-drained area farther from the loch there is a mixed wood. The south shore has a zone of marsh throughout its length, immediately behind which there is a narrow plantation of conifers, with which are mixed here and there, on the damper spots, alders, poplars, willows, etc. (figs. 95–97).

For several years this loch was used as the common receptacle for the sewage of the populous mining district around. The inflowing burn at the west end was then an evil-smelling open sewer, 6 or 8 feet wide, consequently the water of the loch was extremely foul, and an examination of the flora was by no means a pleasant occupation. The local sanitary authorities, however, became enlightened regarding the danger of this mode of sewage disposal, and forthwith adopted a more modern method. Meanwhile, certain colliery owners found in the affluent a convenient means of disposing of their mine water as well as the waste from coal-washing machinery, so that now the burn resembles a stream of ink, and the loch is being silted up with a deposit of coal-dust. The influence of such filthy additions is seen over the whole of the loch, particularly at the west end, where the deep, black mud has an insufferable odour. When the loch received the sewage, the water had a turbid, unwholesome appearance, and was everywhere crowded with plankton organisms, besides which all objects about the shores were covered with filamentous Algæ, chiefly Cladophora fracta, whilst there were innumerable floating masses of Enteromorpha intestinalis and Cladophora flavescens. Now the water is black and dead-looking, and the Algæ have considerably diminished, especially the Cladophoræ, whilst everything is covered with black filth. The marginal vegetation previously mentioned is luxuriant, although somewhat restricted in variety, but the submersed plants are scarce, which is not surprising when one considers the vicissitudes through which the loch has passed.

The plants of the marshy area in the north-west corner are chiefly as follows:—Scirpus lacustris, Equisetum limosum, Heleocharis palustris, Carex rostrata, C. Goodenovii, C. paniculata, C. canescens, Menyanthes trifoliata, Epilobium hirsutum, Polygonum amphibium, Hippuris vulgaris, Phalaris arundinacea, Sparganium ramosum, Comarum palustre, Iris Pseud-acorus, Juncus effusus, J. glaucus, J. acutiflorus, Myosotis palustris, Veronica Beccabunga, Alisma Plantago, Ranunculus Flammula, R. sceleratus, Epilobium palustre, Valeriana officinalis, Lysimachia vulgaris, Cardamine pratensis, Caltha palustris, Spiræa Ulmaria, Viola palustris, Hypnum cuspidatum, etc. There are pure groups of Iris Pseud-acorus standing 5 feet high out of shallow water, and the same occurs at Loch Fitty. Some very large clumps of Cardamine pratensis were also found here. Many of these were propagating vegetatively by the production of plantlets from buds at the base of the leaflets. This method of reproduction is probably in this case due to overfeeding, as the soil is very rich at this corner of the loch. I am unable to say whether these plants produce seed as well, because when I saw them the season had passed. A beautiful variegated variety of Phragmites communis was also seen here. In the water in front of this marshy area the following plants occur, and some of them are also found at other parts of the loch:—Scirpus lacustris, Myriophyllum spicatum, Nymphæa lutea, Castalia speciosa, Potamogeton pectinatus, P. filiformis, as well as its variety alpina, *Blytt*, the last being extremely plentiful in the effluent, and a small submersed form of Alisma Plantago, growing in 18 inches of water, with delicate linear-lanceolate leaves floating on the surface, and linear submerged ones.

The chief plants of the marshy zone along the south shore are—Equisetum limosum, Carex rostrata, C. Goodenovii, Heleocharis palustris, Iris Pseud-acorus, Phalaris arundinacea, Spiræa Ulmaria, Comarum palustre, Caltha palustris, Juncus effusus, etc., all of which grow luxuriantly (figs. 96 and 97).

Burntisland Reservoir is a very irregularly shaped sheet of water about ½ mile long, situated amidst picturesque surroundings 1½ miles north of Aberdour, at an elevation of 290 feet above sea level, and lying between the hills of Dunearn, Balcam, and Cullalo. It was formed by the construction of a short dam at the south-west end, where the maximum depth of 39 feet occurs. Upon the south side, the loose rock and soil have been protected by stonework, which in most places enters the water. Excepting a few lichens and Bryophytes, no vegetation occurs either along this wall or at the dam, but at other parts of the loch, marginal vegetation is generally abundant. The shores, where bare of plants, are either gravelly or muddy, and the water, which is not peaty, has a slightly turbid appearance due to the somewhat impure water of one of the affluents, and to the erosion of the muddy shore by the waves. These matters, however, are about to receive attention from the authorities at Burntisland who own the reservoir, and the proposed alterations will, I fear, eradicate a number of interesting plants from this locality. About the affluent at the east end there is a considerable extent of marsh, which, near the water, is covered with Equisetum limosum and Heleocharis palustris. From this place to about the middle of the loch, where there is a large bay, the flat shore, which is usually exposed in the summer by the falling of the water level, is sandy or muddy, and is covered with vegetation. Littorella lacustris grows out of the water and for some distance up the shore. Then there is a broad zone of Heleocharis palustris, with which a few other species of plants are mixed. Above that a narrow strip of Spiræa Ulmaria grows at the winter water level, and behind the Spiræa there is a luxuriant grass meadow (fig. 98). The Spiræa, as is usually the case with the Rosaceæ, is a gross feeder, and grows uncommonly well along this line, because the storms of winter deposit a supply of rich detrital matter at that place. Similar conditions to those just described for this piece of shore also prevail along the east side of the bay previously mentioned. The wide zone of Heleocharis is cut every summer, and dried for use as bedding for cattle, but chiefly in order to prevent the dead stems being washed into the loch during winter, as the decay of so large a quantity of vegetable detritus would pollute the water. The margin of the bay, otherwise than upon a portion of the east side, has a very sinuous outline, partly because some old gravel quarries have been connected with it. A considerable portion of this bay is quite shallow, consequently a large area of mud is exposed after a period of drought. Upon this exposed mud I found a few specimens of Riccia crystallina, and Mr James M'Andrew discovered a small spot where it was quite abundant. According to my experience, the Ricciaceæ are very rare about Scottish lochs, but Mr William Evans and Mr James M'Andrew discovered five species in the reservoirs around Edinburgh, when the water level was abnormally low, during the dry summer of 1905.* My friend Miss Helen S. Ogilvie has found Riccia Lescuriana in great abundance just below the normal water level of Loch Long on the Sidlaw Hills; and at pools around the Morton Lochs on Tents Muir, some species of this genus abound on the sandy mud when the water has fallen (p. 152). Possibly such Hepaticæ have been previously overlooked, and a more diligent search might prove them to be of more common occurrence about the lochs than is at present acknowledged. Terrestrial forms of Littorella lacustris are very abundant upon the east shore of this bay. Upon a portion of the shore that is evidently only submerged in winter, there was a large prostrate form of this species, with copious stolons as well as flowers. The submerged subulate leaves were dead, and the flattened aerial leaves were slightly ciliated at the margins. In this bay there was also a curious aquatic form of Bryum pallens growing amongst Littorella, etc. (p. 92). One of the deep pools of the bay was almost filled with Myriophyllum alterniflorum, whilst in another Potamogeton obtusifolius, var. fluitans, was very abundant, and at the same place Myriophyllum alterniflorum and M. spicatum were growing together, which is rather unusual. Fig. 99 affords a view of this loch from the north, looking towards Dunearn Hill.

Besides those enumerated above, the following plants occur here :—Nitella opaca, Chara fragilis, Callitriche autumnalis, Apium inundatum, Potamogeton obtusifolius, P. filiformis, P. pusillus, P. perfoliatus, P. prælongus, P. lucens, P. Zizii, Ranunculus peltatus, Polygonum amphibium, Sparganium simplex, S. ramosum and its var. microcarpum, Carex rostrata, C. Goodenovii, C. aquatilis, C. flacca, C. disticha, Alisma Plantago, Caltha palustris, Radicula officinalis, Myosotis palustris, Comarum palustre, Mentha sativa, M. aquatica, M. arvensis, Juncus bufonius, J. glaucus, J. effusus, J. conglomeratus, J. acutiflorus, Epilobium tetragonum, E. palustre, Galium palustre, Stellaria uliginosa, Phalaris arundinacea, Ranunculus Flammula, R. sceleratus.

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* *Trans. and Proc. Bot. Soc. Edin*, 1907, vol. xxiii., part iii., p. 285.

Veronica scutellata, V. Beccabunga, Cnicus palustris, Sagina nodosa, Bartsia Odontites, Stachys palustris, Deschampsia cæspitosa, Achillea Ptarmica, Scutellaria galericulata, Gnaphalium uliginosum, Grimmia apocarpa, var. rivularis, Eurhynchium rusciforme, Bryum argenteum, Hypnum cuspidatum, H. riparium, etc. This a long list of plants for a small loch of comparatively recent formation, and it will be noticed that the greater number of species are those of the marsh zone. A considerable number of water-fowl resort to this reservoir, and they are doubtless responsible for the introduction of so many plants, which, moreover, find the shores a suitable habitat. Scutellaria galericulata, for instance, is not a common plant at the lochs of Fife, but in marshy ground, adjoining the seashore, about 2 miles south-west of Aberdour, it grows in great abundance, and possibly it was transported from there to the reservoir by gulls, etc.

On the top of Balcam Hill, which adjoins this reservoir, there is a small pool about 12 yards long, containing over twenty species of aquatic and marsh plants, two of which, namely Glyceria fluitans and Potamogeton natans, do not occur in the reservoir below.

Otterston Loch is a small shallow sheet of water, 2 miles west of Aberdour. It is closed in by low hills and is entirely surrounded by luxuriant deciduous trees, which also cover a small island in the middle. The water is not peaty, and, although clear, it has a dead, stagnant appearance. The loch is an ornamental sheet of water to Otterston House, which stands upon its north side, whilst the public road from Aberdour adjoins it on the north-east. Except on the west side, where there is an extensive and treacherous bog, the loch is bordered nearly everywhere by low walls or grassy banks (figs. 100–102), so that there is practically no shore, but in several places marsh vegetation overgrows the banks. At the west end the mud at the bottom is deep, black, and fetid; at the east end there is much less mud, and there some parts of the margin are sandy, or a narrow zone of stones may even occur (fig. 102). Ceratophyllum demersum is so abundant that the loch is almost choked with it, and in summer, when the plants are at the surface, the manipulation of a boat over the water is a matter of some difficulty. Doubtless many plants that otherwise would thrive in this loch are excluded by the Ceratophyllum, which appears to be gradually extending, for I have noticed that Ranunculus Baudotii, which was abundant at the east side of the loch in 1903, had in 1908 become almost extinct by the extension of the Ceratophyllum. The latter, however, is not able to hold its own in the marginal zone against the Polygonum amphibium which grows there (figs. 100 and 101), possibly for two reasons. (1) The Ceratophyllum is favoured by water of some depth, to the bottom of which it sinks in order to hibernate, whilst the Polygonum grows best in comparatively shallow water. (2) Owing to the luxuriant development of the floating leaves of the Polygonum, which obstruct the free access of light to the water below, the Ceratophyllum is not able to thirve in this darkened area, and consequently becomes extinct at the margin of the Polygonum association. Notwithstanding its absence in a few small areas, the quantity of Ceratophyllum in this loch is extraordinary. Equally striking is the flora of the bog at the west end. Considerable portions of it are covered with associations of Menyanthes trifoliata, the individuals of which are so closely compacted that no other plants can thrive amongst them. Ranunculus Lingua is also very abundant and grows in large patches, the vivid yellow of its masses of flowers affording an agreeable tone to the sombre green of the tussocks of Carex paniculata (fig. 103), which dominates the greater portion of the bog.

Besides those already mentioned, the following plants occur here:—Callitriche autumnalis, Potamogeton Zizii, Zannichellia palustris, Ranunculus circinatus, Myriophyllum spicatum, Lemna minor, L. trisulca, Cladophora crispata, Carex rostrata, Heleocharis palustris, Cicuta virosa, Sparganium simplex, S. ramosum, Epilobium hirsutum, Ranunculus Flammula, Caltha palustris, Myosotis palustris, Galium palustre, Spiræa Ulmaria, Mentha aquatica, Juncus effusus, Phalaris arundinacea, Montia fontana, etc. [Scirpus sylvatica, close to the loch.—J. M'A.]. A number of Bryophytes occur about the banks and on fallen timber, particularly at the south and west sides, but as these are chiefly forms that grow in damp woods and similar places they cannot be named as belonging to the loch.

Loch Fitty is situated amidst a mining and agricultural district 3 miles west of Cowdenbeath. It is a mile long by $\frac{1}{3}$ mile wide, is at an elevation of 413 feet above sea level, and has a maximum depth of 17 feet. The water is clear but it has a flat, dead appearance, especially so in autumn when the abundant vegetation, particularly the Characeæ, is decomposing. A fine tow-net used in the middle of the loch at the end of September caught a very pure collection of Asterionella formosa. Many of the submersed plants were heavily incrusted with lime, which proves the presence of that substance in the water. Some plants, *e.g.* Potamogeton Zizii and P. perfoliatus, were so weighted with this substance that many of them were lying on the bottom instead of rising up to the surface. The shore at the north side is stony, gravelly or sandy, and almost destitute of marsh plants. At the south side a portion of the shore is composed of a bank of shale, which has been thrown out from an adjacent mine, and a number of aquatic plants occur in the pools and little bays formed by the irregularities in this substance. At other places upon this side of the loch the shore is gravelly or sandy, and bears more plants than the opposite side does. The chief affluent enters the loch at the west end, previous to which it has a very sinuous course for about a mile through an alluvial flat consisting of pasture or arable land, doubtless at one time covered by the water of the loch. Near the loch this flat merges gradually into a bog several acres in extent (fig. 104). At the east end, whence flows the effluent, and where also another burn enters the loch, there is a similar but much less extensive bog (fig. 105). The loch is shallow throughout its area, a depth of 10 feet being seldom exceeded. The deepest water occurs opposite the mine on the south shore, where a depth of 17 feet may be sounded; this depth is probably due to the bottom sinking on account of the mining operations below. The photic zone extends to a depth of 12 feet, beyond which black mud occurs and no living vegetation. The stones about the shores are nearly everywhere thickly covered with Cladophoræ, which bear an extraordinary quantity of Diatomaceæ, chiefly of the genera Diatoma, Gomphonema, and Cocconeis. A remarkable feature is the vast amount of Potamogeton pectinatus growing in water from 6 to 12 feet deep, the slender stems carrying the flowers to the surface even from the greatest depth. Here and there at the marshes are pure groups of Iris Pseud-acorus, with leaves 4 or 5 feet high, standing out of the water as little islands. A considerable portion of the bottom is covered with Chara fragilis and its vars. fulcrata and delicatula, C. aspera and its vars. subinermis and capillata, and C. contraria, as well as with a number of other plants. Litorella lacustris and Heleocharis acicularis are scarce. Callitriche autumnalis is very abundant; besides the type there is a form differing slightly in the leaves and fruit. About the marshes aquatic and terrestrial forms of C. stagnalis abound. Potamogeton rufescens, the type as well as a very leafy, barren form, is abundant. P. pusillus, the type as well as a narrower-leaved form, P. filiformis, the type and a much longer-leaved form, and P. pectinatus are all very plentiful; indeed, the three last-mentioned species are so abundant that their fruits, which in the autumn are washed upon the shore, formed in a few places a stratum over the sand an inch deep. Potamogeton perfoliatus, P. Zizii, and P. obtusifolius are all very abundant, while P. prælongus, P. natans, and P. polygonifolius are all scarce. Myriophyllum spicatum is very plentiful, but M. alterniflorum is scarce. Anacharis Alsinastrum occurs sparingly, and the plants are weak. The following also occur, but none of them is abundant:—Nitella opaca, Juncus fluitans, Ranunculus peltatus, Nymphæa lutea, Polygonum amphibium, Sparganium simplex, var. longissimum, the last near the affluent at the west end, and

Fontinalis antipyretica on submersed stones, but chiefly at the north side of the loch. There is a small association of Scirpus lacustris on the south side and a few plants elsewhere, but they are all rather dwarfed, standing only about 3 feet high out of the water. Phragmites communis is represented by a few sparse and dwarfed patches at the marshes. Carex aquatilis is extremely abundant and covers large areas of marsh; when growing in water it is 3 feet high, but in drier places it only attains half that size (fig. 104). The following marsh plants also occur at this loch:—Equisetum limosum, Hippuris vulgaris, Heleocharis palustris, Sparganium ramosum, S. simplex, Iris Pseud-acorus, Alisma Plantago, Epilobium hirsutum, Carex rostrata, C. Goodenovii, Comarum palustre, Menyanthes trifoliata, Myosotis palustris, Phalaris arundinacea, Juncus acutiflorus, J effusus, J. glaucus, J. bufonius and its var. fasciculatus, Galium palustre, Veronica scutellata, Pedicularis palustris, Mentha aquatica, M. sativa, M. arvensis, Caltha palustris, Ranunculus Flammula, Equisetum arvense, E. palustre, Angelica sylvestris, Spiræa Ulmaria, and Deschampsia cæspitosa. Hepatics are scarce, but a number of mosses are common in the marshes, the following being the most abundant:—Climacium dendroides, Hypnum stramineum, H. cuspidatum, H. stellatum, Hylocomium squarrosum, and Aulacomnium palustre.

Town Loch, which is only a few hundreds of yards long, is about 2 miles north of Dunfermline, and close to the mining village of Townhill. At the time of my visit the water had fallen several feet owing to dry weather, and a large expanse of uninviting shore composed of sandy gravel, mud, and coal-dust, was exposed. At the full water level there is a zone of vegetation composed chiefly of plants of the damp meadow type, with which are mixed some of those species usually associated with the shores of a loch. The water is extremely foul, as the loch is used as a receptacle for sewage. It is, in fact, little more than a large and dirty horse-pond. The bottom at the centre is somewhat raised, and I could see from the margin that this part was covered with aquatic plants. There is no boat at this loch, however, and I did not feel inclined for a swim in the filthy water, although, at one end, a number of urchins were disporting themselves with great gusto. These I approached, and by the judicious distribution of a few coppers amongst them heaps of plants from different parts of the loch were quickly brought to shore. There were, however, only two species, viz. Chara fragilis, the type form in a very prolific condition, and a robust form of Potamogeton flabellatus. At the west end there was a large association of Polygonum amphibium, and smaller ones of Equisetum limosum and Carex rostrata. Some parts of the exposed shore were covered with Agrostis vulgaris, Alopecurus geniculatus, and Polygonum aviculare. The other plants noticed here were—Littorella lacustris, Alisma Plantago, Heleocharis palustris, Juncus effusus, J. acutiflorus, J. bufonius, var. fasciculatus, Mentha arvensis, Equisetum arvense, Gnaphalium uliginosum, and Potentilla anserina.

Between Dunfermline and Saline there are two reservoirs at which I had intended to make detailed observations, but was prevented doing so by unfavourable weather, and I have not been able to visit them again. It is, however, of some interest to note that Potamogeten rufescens grows here in great abundance.

In a small pool at Patricks Walls, which is situated in a hollow surrounded on three sides by steep craigs, I saw with a telescope what was probably Nymphæa intermedia, but could not reach it on account of bog. I am led to record these observations because neither of these plants is common in Fife, but the latter and a variety of the former occur in a loch on the Cleish Hills, a few miles to the north.

Loch Glow is situated in an open, wind-exposed position on the Cleish Hills (fig. 106). These hills are for the most part covered with a grass-like formation of plants, below which in many places there is peat. The loch is the largest of a series of four; it is ¾ mile long by ½ mile broad, and is situated at an elevation of 900 feet above sea level. The original loch has been deepened by the construction of a short dam at the east end, and it is now used as a reservoir. The water is clear, but slightly peaty. The north shore is rocky, stony or more rarely sandy, and the south shore is mostly peaty. A few leaves of Littorella lacustris, that had been washed upon the shore, were the only evidence of the existence of submersed aquatic plants in the loch that I could discover without the aid of a boat, which at the time of my visit was out of repair. Marsh plants also are practically absent. It would be reasonable to expect a number of submerged plants in this loch, as Black Loch, which drains into it, has several species. The shores, however, are scarcely suited for the development of a marsh flora.

Black Loch, recently mentioned, is a small sheet of water about ½ mile west of Loch Glow, and is surrounded by hills. The water is somewhat peaty, and there is scarcely any shore save a few stony places here and there, as the grassy moor terminates in a bank at the water's edge. There is a thin association of Phragmites communis stretching along the south shore (fig. 107). Carex rostrata occurs in patches all around the margin, but particularly at the west end, and there are small associations of Equisetum limosum. Nymphæa intermedia occurs abundantly at the west end. Myriophyllum alterniflorum, Potamogeton perfoliatus, and P. prælongus are fairly common, whilst P. rufescens, var. spathulifolius,* is extremely abundant outside the zone of Nymphæa intermedia in 7 or 8 feet of water. Mr A. Bennett informs me that as regards Scotland he had previously only seen this variety of Potamogeton from Loch Fada, Isle of Colonsay, Argyllshire. Littorella lacustris, Carex Goodenovii, Juncus effusus, J. acutiflorus, and J. lamprocarpus were the other abundant plants, whilst some other common species were less plentiful.

On the 18th of May no new shoots of Phragmites communis had appeared above the water at this loch, which is about 900 feet above sea level; whilst on the previous day at Loch Gelly, which is about 400 feet above sea level and only 8 miles away, the young shoots of the same species were over a foot above the water. At Loch Gelly the plant grows to a height of 8 or even 10 feet, whilst the form at Black Loch attains only half that size. Possibly they are two distinct physiological forms, whose morphological difference is most easily expressed in terms of size. It would be interesting to transpose specimens from one loch to the other in order to discover whether the form would change.

Loch Dow is a small oval sheet of water situated in a hollow of the grassy moor, ½ mile north-east of Loch Glow. The water is slightly peaty, and the stony or rocky shores on the north and east are narrow, with a sparse vegetation, or the moor meets the water without the intervention of a shore. Extending around the south and west sides there is an extensive bog, mostly occupied by Carex rostrata, which advances into the water on the one hand, and merges into the grass formation of the moor on the other (fig. 108). There are associations of Equisetum limosum on the south and west. Hydrocotyle vulgaris is abundant everywhere, and there are also a number of other common species.

Loch Larg is a few hundreds of yards north of the last mentioned, and is very similar to it, excepting that its eastern shore is more stony. There is a flat boggy area along the west side, which is covered near the water with Carex rostrata. Adjoining the moor this bog is overgrown with Calluna vulgaris, Polytrichum commune, P. gracile, Sphagnum cymbifolium, S. intermedium, etc. A slight but sudden rise of the ground causes an abrupt termination to the vegetation just mentioned, and in its place associations of grass-like plants, amongst which Scirpus cæspitosus is dominant, extend towards the moor (fig. 109). The line of demarcation between the Calluna and the grass-like associations is quite sharp, and probably marks the original extent of the loch.

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* Fischer, "Die Bayrischen Potamogetonen und Zannichellien," *Ber. Bayr. Bot. Ges.*, xi. (1907), pp. 20–162.

There is no boat on any of the three last-mentioned lochs, so that it is impossible to say anything about their submerged plants except such as could be seen from the shore, or washed there, or gathered by swimming after them. Besides the plants already enumerated the following species were more or less common to these three lochs:—Littorella lacustris, Lobelia Dortmanna, Myriophyllum alterniflorum, Fontinalis antipyretica, Chara fragilis, var. delicatula, Castalia speciosa, Potamogeton polygonifolius, Equisetum limosum, Carex Goodenovii, Ranunculus Flammula, Eriophorum vaginatum, Juncus acutiflorus, J. effusus, Cardamine pratensis, Montia fontana, var. minor, Hydrocotyle vulgaris, Blindia acuta, Sphagnum intermedium, S. cymbifolium, Philonotis fontana, Aulacomnium palustre, Polytrichum commune, P. gracile, Hypnum commutatum, H. revolvens, H. scorpioides, H. cuspidatum, H. fluitans, Webera nutans, Bryum bimum, B. pallens, B. argenteum, Ceratodon purpurens, Rhacomitruim aciculare, Scapania undulata, Pellia epiphylla, and Diplophyllum albicans.

Harperleas Reservoir is situated on the Lomond Hills, at an elevation of 848 feet above sea level. It is about ½ mile long, and is of an irregular shape, with clear but somewhat peaty water. It has been formed by the construction of a long dam at the east end, and there the maximum depth of 41 feet occurs. The south shore is either stony or muddy, and at some places the bank enters the water without the intervention of a shore. At the north and west the shore is flat, and muddy or peaty, and is covered with a luxuriant vegetation, whilst there are very few plants at the south shore, and none along the dam. A zone of Equisetum limosum, behind which are Carex rostrata and Juncus effusus (fig. 110), extends along the greater part of the north side. The Equisetum is intermingled with Littorella lacustris, which also runs up the shore and forms a dense sward in some places. Occasionally considerable areas of exposed mud were covered with Juncus fluitans, which was reverting to the terrestrial type—J. supinus—which it somewhat resembled. Other normally submersed plants were assuming a terrestrial habit and forming a meadow-like sward upon the exposed shore, particularly Ranunculus aquatilis, Heleocharis acicularis, Polygonum amphibium, Potamogeton polygonifolius, and P. heterophyllus. The normal aquatic form of the last mentioned was very abundant at this loch, and those plants left upon the exposed mud were developing new shoots with aerial leaves similar to the coriaceous floating ones but smaller, the shoots with thin submersed leaves having completely withered away. At the north-west end a portion of the shore presented a remarkable appearance through being covered with dead tussocks of Molinia cærulea, which had been drowned during some period when the water level was abnormally high (fig. 111). Salix repens covers the higher portions of the shore in some places at the west end.

A little to the east of Harperleas is Ballo Reservoir, both being situated on an upland plateau which forms the south flank of the East and West Lomond Hills. These reservoirs are surrounded by moor of the grass or heather type, or by a superior pasture-land which is due to cultivation. Harperleas Reservoir is treeless, but Ballo has a plantation of conifers upon its south-west shore (fig. 112). There are also a few plantations in the neighbourhood of the reservoirs, which pleasingly relieve the sameness of the moor, and add a picturesque charm to this pleasant, although small, stretch of upland country.

Ballo Reservoir has a somewhat pear-shaped outline, with the narrow end towards the south-east, in both of which respects it resembles Loch Leven on a small scale. It is about a mile long by ½ mile wide at the broadest part. In general features it much resembles Harperleas Reservoir, but there is less variety in the species of plants. At the north-west end there is an extensive peaty-muddy flat, covered with an association of Juncus effusus. This flat area extends out into the loch for some distance, and in the dry season is exposed by the falling of the water (fig. 112). It is covered with Littorella lacustris, Heleocharis acicularis, and Juncus fluitans, all of which assume the terrestrial habit when the water has receded. At the same end of the loch, but nearer the north side, Hydrocotyle vulgaris extends over a considerable area and forms a dense sward. Equisetum limosum forms a zone along a portion of the north shore, as at Harperleas Reservoir, behind which there is a strip of boggy ground covered with Carex, etc., and at one place there is an association of Typha latifolia. The shore along the north and east is flat and peaty, and a wide strip of it, exposed by the falling of the water (fig. 113), was more or less covered with Juncus fluitans, which was reverting towards the terrestrial type. Time did not permit me to make use of the boat at either of these reservoirs; but as the water was very low when I was there, probably there were few plants in the water that could not be observed by other means.

Besides those already mentioned, the following species were more or less common to both lochs:—Chara fragilis, var. delicatula, Fontinalis antipyretica, Myriophyllum alterniflorum, Ranunculus aquatilis, Potamogeton natans, P. polygonifolius, Heleocharis palustris, Polygonum amphibium, Callitriche hamulata, C. stagnalis, Comarum palustre, Mentha aquatica, M. sativa, Carex rostrata, C. Goodenovii, C. flava, Juncus supinus, J. acutiflorus, J. lamprocarpus, J. effusus, J. bufonius, Myosotis palustris, Caltha palustris, Peplis Portula, Veronica scutellata, Gnaphalium uliginosum, Ranunculus

Flammula and the little R. reptans, which, however, is rather scarce here; Hydrocotyle vulgaris, Spiræa Ulmaria, Galium palustre, Deschampsia cæspitosa, Hypnum fluitans, H. cuspidatum, and Aulcomnium palustre.

Loch Leven is situated in the lowest part of a somewhat oval strath called the Plain of Kinross, which is bounded by the Cleish Hills, Benarty Hill, the Lomond Hills, and the Ochil Hills (fig. 114). It is somewhat pear-shaped in outline, with the apex lying to the south-east. It is 3⅝ miles long by 2⅝ miles wide at the broadest part. The surface of the loch is 350 feet above sea level; and as the land for some distance around is below the 400-feet level, it must at a former period have been very much larger. It was artificially reduced in size in 1845, when its level was lowered 4½ feet. On account of the shallow marginal zone, this slight lowering of the level reduced the area by about 1400 acres. For its size it is an extremely shallow loch, the greater portion of it being less than 15 feet deep. Indeed, along the east shore an area almost 3 miles long by nearly a mile broad is mostly less than 9 feet deep. It has, however, two depressions, each having a depth of about 80 feet, one to the west of St Serf's Island, and the other to the north-east of Scart Island. If the affluent were lowered 22 feet, so as to reduce the level of the loch by that amount, about 3000 acres of land would be reclaimed. There are six islands in the loch. The largest of them, called St Serf's Island, has an area of about 80 acres; it is quite treeless, and is utilised as a rabbit warren. Castle Island is covered with deciduous trees, and has an extent of about 5 acres (fig. 115). The outline of both these islands curiously resembles that of the loch, but their apices lie in the reverse direction. The other islands are quite small. The shores are everywhere flat and usually sandy, particularly on the east side, where the sand is sometimes blown into small dunes. More rarely the shore is composed of stones, or there is no shore because meadow-land comes down to the water's edge. In a few places there is a narrow zone of marsh extending a considerable distance along the shore, as, for example, upon both the east and south sides, opposite St Serf's Island (figs. 116 and 117). In many places there are large quantities of vegetable remains, chiefly those of Chara and Anacharis, lying upon the shore at the winter water level. The flat shores of this loch are in many parts very much exposed to wind, and due to this influence is the fact that some plants which ordinarily grow erect here assume a prostrate habit, such, for example, as Equisetum arvense, E. palustre, Juncus bufonius, J. acutiflorus, J. supinus, Ranunculus Flammula, etc. There are two or three associations of Phragmites communis, as well as of Heleocharis palustris and Equisetum limosum, that enter the water here and there, otherwise there are no plants of semi-aquatic type in the water of the loch. The water is fairly clear, and is not appreciably peaty. The bottom of the loch from the shore to a depth of about 15 feet consists largely of firm sand, which is, however, frequently dirty and mixed with mud. Where the bottom is of this nature, which is particularly the case along the east side, it is usually carpeted with Chara aspera, or its var. subinermis, and sometimes with C. vulgaris and C. fragilis, to a depth of 14 or 15 feet. The growth of these plants, particularly the first mentioned, at depths of from 4 to 8 feet, is prodigious, but they thin out towards the shallower water on the one hand, and towards the deeper water on the other. Nitella opaca occupies considerable areas, also where the bottom is sandy, and at similar depths to the Chara, but it has a tendency to be most abundant in slightly deeper water than that at which the maximum growth of the Chara occurs. On the few areas where the bottom from near the margin to a depth of 15 feet is of mud, as, for example, in some places at the west side of the loch and in the bay at the east end of St Serf's Island, Anacharis Alsinastrum grows with such extraordinary vigour that in the summer, when the plants are near the surface, it is very difficult to row a boat through them.* At greater depths than about 16 feet no living vegetation of the higher type occurs, and mud covers the bottom nearly everywhere. This mud, which is usually blackish, with a somewhat offensive odour, was in August crowded with worm-like larvæ at many parts of the loch. Among a number of other plants which grow in the water, the most abundant is probably Potamogeton perfoliatus. The boat-keeper at the loch informed me that previous to the extensive development of the Anacharis this Potamogeton was extremely abundant, and that it had been partially exterminated by the former plant. Besides those already mentioned, the following plants occur at this loch:—Littorella lacustris, Callitriche autumnalis, Heleocharis acicularis, Tolypella glomerata, but very scarce; Myriophyllum spicatum, M. alterniflorum, Potamogeton filiformis, P. pusillus, P. obtusifolius, P. heterophyllus, and in pools on the shore the var. terrestris, *Schlecht.*, P. prælongus, P. Zizii, P. lucens,

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* It is supposed that this plant was introduced into Loch Leven by an itinerant hawker of gold-fish, who, changing the water in his tanks at the loch, threw out some of the plant. This is quite possible, as Anacharis is commonly used for aerating the water in aquaria, and is sold by dealers for that purpose. In non-peaty water containing a supply of suitable plant food-salts the smallest scrap of this plant bearing a whorl of leaves will grow and increase very rapidly, whether floating or attached to the bottom. That the Anacharis has not become general at other non-peaty lochs of this Area is probably because (1) it propagates vegetatively, as only female plants occur, consequently no seed is produced for dispersal by birds; (2) the form of the plant is such that it is not likely to be carried inadvertently on the legs or bodies of birds; (3) the only effluent of Loch Leven flows directly into the sea without entering any other loch.

Ranunculus aquatilis, Polygonum amphibium, Glyceria fluitans, Lemna minor, Callitriche stagnalis, the two last only in pools on the shore; Carex rostrata, C. aquatilis, C. Goodenovii, C. hirta, on the sandy shores, and growing like C. arenaria on the seashore; Alisma Plantago, A. ranunculoides, Phalaris arundinacea, Veronica Beccabunga, Comarum palustre, Mentha sativa, M. aquatica, M. arvensis, Eriophorum polystachion, Myosotis palustris, Montia fontana. Iris Pseud–acorus, Menyanthes trifoliata, Radicula officinalis, Juncus effusus, J. lamprocarpus, J. acutiflorus, and a dwarf prostrate form of it with scarcely any rhizome, growing on the exposed sandy shores; J. bufonius and its var. fasciculatus, Equisetum palustre, Pedicularis palustris, Mimulus Langsdorffii, Lysimachia nummularia, Galium palustre, Stellaria uliginosa, Cardamine pratensis, Angelica sylvestris, Ranunculus Flammula and its var. pseudo-reptans, as well as intermediate forms; R. reptans, R. hederaceus, Caltha palustris, Spiraea Ulmaria, Hydrocotyle vulgaris, Spergularia rubra, Gnaphalium uliginosum, Sagina nodosa, Sphagnum acutifolium, Philonotis calcarea, P. fontana, Climacium dendrioides, Bryum bimum, Hypnum falcatum, H. commutatum, H. scorpioides, H. cuspidatum and Hylocomium squarrosum. These mosses are most abundant at the marshy places on the south shore. Hepatics are quite scarce.

The Isle of May is situated at the entrance to the Firth of Forth, and is about 5 miles from the coast of Fife. It can be reached most easily by engaging a sailing-boat from either Anstruther or Crail, according to wind and tide. The only inhabitants of the island are the lighthouse keepers and their families; and there is no public communication with the island from the mainland excepting in the summer, when an occasional steamer from Leith may, if the sea is calm, land excursionists there for an hour or so. The island is a little over a mile long by about $\frac{1}{3}$ mile wide, and consists of a mass of volcanic rock. Almost the whole of the eastern side rises from the sea at a gradual inclination (figs. 118 and 119), but the western side is precipitous, and the black dolerite cliffs, which occasionally exhibit magnificent columnar structure, rise perpendicularly from the sea to a height of 150 feet (fig. 122). Thousands of sea-birds of various kinds find a congenial home upon this cliff. The countless little platforms that are formed by the ends of the basalt columns suit them admirably both as resting-places and as sites for nidification. The black cliffs are whitened by the droppings of the birds, and when seen from a distance of 2 or 3 miles, under the soft refulgence of the declining sun of a gentle summer's eve, this side of the island presents a magnificent spectacle.

I was induced to visit this isolated spot in order to investigate a small loch which is there, thinking it might afford something of interest because of the numerous water-birds that visit the island during their migrations. The loch, which is quite small, is situated in a ravine that divides the island obliquely in the direction S.E. by E. and N.W. by W. From the rocky and precipitous nature of the ravine one might imagine the pool to be a little lochan high on the mountains. The extensive engine-house at the east end and the cement dams at both the east and west ends, however, quickly dispel such a pleasant illusion. The water, which is maintained at a depth of about 7 feet by the dams, is used for the engines that generate the electricity for the lighthouse and the compressed air for the fog-horn. The light from the lighthouse, which is situated at the highest part of the island near its centre, is a revolving one, showing four rays of white light every half-minute. The light is produced from a single pair of very large carbons, and is one of the most powerful around the coast of Britain, although it is said not to penetrate to so great a distance as the light given by oil when the atmosphere is thick. The fog-horn, which is worked by compressed air, sounds four consecutive notes, namely—high, low, high, low. The horn is situated at the south end of the island, the compressed air being conducted to it from the engine-house through a strong iron tube. Upon one occasion I happened to be close to the horn when a fog suddenly descended and it was consequently put into action. The noise was appalling, and reverberated from rock to rock as if it would rend them asunder.

No aquatic Phanerogams or higher Cryptogams exist either in the water or about the shores of the little loch, but the water is coloured yellowish-green by the abundance of minute Myxophyceæ, Bacteria, Infusoria, Entomostraca, and by the waste water from the adjacent engine-house. The water is so discoloured that the bottom can only be seen at a depth of a few inches, and the engineer informed me that the discoloration is maintained throughout the year. It must not be imagined, however, that the cliffs about the loch are bare of vegetation, for, besides grassy slopes and banks, the rocks and crannies are clothed with a variety of plants such as are common to the maritime cliffs of the adjacent mainland.

Being disappointed with the loch, I gave some attention to the terrestrial flora, and the following is a compendium describing what I saw in August:— There is no peat on the island, and plants usually associated with that substance are consequently absent; neither are there any trees, and, beyond two or three small gardens and an enclosure for grass, cultivation is nil. The dominant vegetation, as might be expected, is that of the maritime cliff type, the species of which are frequently dwarfed by the poverty of the soil and by the desiccating action of the wind. In some places a fine close sward is maintained by rabbits, which abound. There is no sandy shore at any part of the island, because nearly everywhere rock abruptly enters the sea. There is, however, at the north-west end a little beach about 20 yards long, composed entirely of finely broken shells; and at the south-west end, immediately to the east of some bold dolerite stacks that stand out in the water, there is a small stretch of pebbly beach. No vegetation grows upon either of these places, so that the usual maritime sandy or pebbly shore plants are absent from the island. Between the rocks, especially upon the low-lying east side of the island, and even at the highest parts, numerous little pools are formed by the collection of rainwater in the hollows, and a few semi-aquatic plants occur at such places (fig. 121). Near the southern point of the island there is a small damp, open cave, which was probably excavated by the sea at a former period, when the 25-feet raised beaches were formed upon the adjoining mainland. This cave has been excavated in a reddish material, comparatively soft and easily crumbled, which, as Messrs Peach and Horne, of the Geological Survey, inform me, is due to the decomposition of the exfoliating teschenite lying in a fissure of that rock. This place contains a few plants not observed elsewhere upon the island, and it will subsequently be referred to as the cave. Upon the east side of the island the rocks, by their gradual rise from the sea (fig. 118), are admirably adapted for being swept with spray during every stiff easterly breeze, so that over a rather wide zone these rocks are perfectly bare of soil, and the only vegetation that can exist consists of certain maritime lichens. These grow in great abundance and cover almost every rock, imparting a vivid coloration to the otherwise sombre aspect, the grey Lecanora parella, the brown Physcia aquila, the orange Physcia parietina, and the glaucous Ramalina scopulorum being particularly noticeable (fig. 120). A little higher up the incline, where the drenching spray has been insufficient to entirely wash away all soil, and where some mould has been retained in the interstices of the rocks, the vanguard of the phanerogamic vegetation appears. This is usually in the form of dwarf cushion-like tussocks of Armeria maritima, which adds its own peculiar charm to the coloration of the lichen-besprinkled rocks around (fig 119). The Armeria in such situations produces roots of surprising length, which penetrate the fissures of the rocks until an agreeable soil is reached (fig. 123). Algæ are generally scarce, and cannot be said to take any part in the formation of the plant-covering of the island. The same remark applies to the rocks at the margin of the sea, for they are in most places singularly poor in species of marine Algæ, and are often quite destitute of such plants. The larger Fungi also appear to be very scarce. Besides the lichen-covered rocks already mentioned, the island owes a good deal of its plant-covering to lichens, of which the following species are the most conspicuous:—Ramalina polymorpha, both large and small forms, R. scopulorum, and Alectoria jubata are all abundant, especially on cliffs and the vertical sides of rocks, from which they hang in profusion. Parmelia saxatilis, Cetraria aculeata, and Sphærophoron coralloides cover rocks that are beyond the influence of the sea spray. Amphiloma lanuginosum is abundant in shady corners about the rocks and cliffs, and Peltigera polydactyla occurs amongst rough grass, but is not abundant.

As would be inferred from the nature of the environment, Hepaticæ are scarce. Lophocolea bidentata occurs about pools and other damp places, and in the cave. Jungermannia ventricosa grows in damp places below rocks, but is not abundant; Nardia scalaris, growing with Cephalozia Starkii, also Lunularia vulgaris and Conocephalus conicus, carpet the sides of the cave. Mosses are of much more frequent occurrence. Grimmia maritima and Webera nutans are common on rocks; a form of the latter species was also fairly abundant. Respecting it, Mr H. N. Dixon, to whom a specimen was submitted, writes as follows:—"It is a form or variety which I have gathered once or twice, usually in mountainous country, and it comes near the mountain form which I have referred to in the Handbook [of British Mosses], 2nd edition, as like W. commutata." Polytrichum Juniperinum occurs in scattered patches all over the island. Mnium hornum, Amblystegium serpens, and Eurhynchium prælongum are all common in damp places throughout the island.*

The only ferns observed were Asplenium marinum, which grows sparingly about the cliffs and in the cave, and A. Ruta-muraria, which is very scarce. Excluding weeds in the cultivated spots and on ground adjacent to them, the most abundant Phanerogams are as follows:—Ranunculus repens, very common; R. aquatilis, rather dwarf specimens in some of the pools; Cochlearia officinalis, very abundant in places; several variations occur in accordance with the environment, and in the cave there is a very slender and somewhat pellucid form; Cerastium tetrandrum, scarce; C. triviale, very abundant; Stellaria media, common near the houses, on rubbish-heaps, etc.; Silene maritima, very abundant, and in the cave there is a very long-leaved form; Sagina apetala, common; Potentilla anserina and P. tormentilla, both abundant; Sedum anglicum, very abundant about the rocks (fig. 124); Callitriche verna and C. stagnalis, both abundant in pools; Conium maculatum, sporadic in sheltered places; Apium inundatum, very scarce in a few pools; Heracleum Sphondylium, frequent; Ligusticum scoticum, very abundant and luxuriant on the cliffs, etc.; Galium verum, common; Bellis perennis, scarce, near the houses; Senecio Jacobaea, scarce; Cnicus lanceolatus, plentiful; C. arvensis, very abundant; Leontodon autumnalis, abundant; Glaux maritima, very abundant, being often one of the constituents of the sward; Rumex Acetosa, very abundant; R. crispus, frequent; R. conglomeratus, scarce; Armeria maritima, very abundant all over the island, and forming a close sward where cropped by rabbits or sheep; Plantago media, not abundant; P. maritima, abundant; P. Coronopus, very abundant; Littorella lacustris, abundant in small pools; Urtica dioica, abundant, but generally near the houses; Atriplex patula, various forms abound nearly everywhere, from little fruiting plants 2 inches high in exposed places to specimens a foot high in sheltered spots; sometimes the dwarf forms produce a loose sward; Juncus bufonius and its var. fasciculatus, common about the pools; J. acutiflorus, dwarf forms about the pools, but not abundant; Heleocharis palustris, dwarf forms a foot or less in height fill some of the pools (fig. 121); H. uniglumis, scarce; Carex Goodenovii, dwarf forms about the pools, but not abundant; C. vulpina, abundant about the pools. Agrostis alba, A. vulgaris, Holcus lanatus, and Festuca ovina, var. hispidula, are the dominant grasses, and provide the chief plant-covering to the soil of the island. Festuca ovina, var. glauca, is common about the rocks and drier places. No viviparous forms of F. ovina were observed.

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* Since the above was written, Mr William Evans has published his observations on the Bryophytes of the Isle of May, the specimens having been collected there at various times from 1885 to 1908. He mentions 18 species of mosses and 7 hepatics, most of which are very scarce.—*Trans. and Proc. Bot. Soc. Edin.*, 1908, vol. xxiii., part iv., pp. 348–351.

V.—CONCLUDING REMARKS.

In the seven Areas included in this and the former paper, about 175 lochs have been visited; these vary in size from what are practically inland seas, such as Loch Ness, to mere ponds, like Lochan Diota. These lochs have to a considerable extent their individual floristic peculiarities, and this fact inhibits the process of condensation of such features into a short summary. The lochs may, of course, be grouped in accordance with their striking physical characteristics, such as elevation above sea level, exposure to wind, nature of shore, depth of water, condition of the bottom, whether rocky, stony, sandy, clayey, muddy, etc., kind of water, whether peaty or non-peaty, rich or poor in plant food-salts, etc.; and these characters very largely depend upon the physiographical features of the surrounding country. When the combination of such factors respecting any loch is known, the plants likely to be found there may be roughly indicated, but this apparent simplicity is frequently modified by other agencies.

The laws which govern the geographical distribution of aquatic plants cannot be fully understood until science has revealed more facts regarding the ecology of the plants than it at present possesses; it is therefore futile to attempt the deduction of general laws, with only an inadequate knowledge of the phenomena to be generalised. During the last great glacial epoch it is certain that all forms of the higher plants were banished from the greater portion of Scotland. Towards the end of that era, as the mantle of ice and snow began to retreat, so would plants encroach again over the country from the region to the south, where its influence had been less severe. What precise causes influenced most this gradual northward march of aquatic and terrestrial plants cannot now be determined, but probably they were such as affect the distribution of plants at the present day. The plants no doubt followed the lines of least resistance and greatest traction, not only in their geographical advance, but also in their adaptations of structure and function to the varying environments. These lines must necessarily be ramified and involved, perhaps to an insoluble degree; yet on them are the secrets of plant geography to be discovered, on the basis of physiological anatomy and plant psychology. By such methods a most interesting inquiry would be—What is the equilibrium that has been attained between the forces of resistance and traction that has caused certain species to arrive at, and remain in, restricted areas? This is a subject bristling with difficult chemical and physical complications, combined with the various influences resulting from the never-ceasing action and reaction, not only between the different members and associations of the flora, but between the flora and fauna as well; and it is at present impossible to set down a complete satisfactory statement of the ecology of any single group of aquatic plants. We must, therefore, for the moment leave the final generalisation of the causes which govern the distribution of plants, and content ourselves with the routine work of taking evidence of that which occurs; not being too eager to surround ourselves with metaphysical hypotheses which seek to explain the observed phenomenon by a noumenon, nor to cloak our ignorance and befool our senses with vague concepts that transcend actual demonstration, and, when analysed, explain to our intelligence nothing whatever. On p. 172 I gave a possible explanation of the introduction of Anacharis Alsinastrum into Loch Leven, and of its restriction to that loch; but I am quite ignorant of the exact reason why it should flourish so exceedingly there, and not in Loch Fitty, where it also occurs, but very sparingly. Again, the restriction of certain plants to particular localities may be accounted for by observing that they are ill adapted for any mode of dispersal to which they are likely to be subjected; it is then difficult to understand their introduction to their present situation. It is not easily explained why Equisetum limosum, Carex rostrata, Phragmites communis, and others should be so widely distributed about the margins of all kinds of lochs, whereas Cladium Mariscus, an equally dominant species, should be restricted, in the Areas under discussion, to a few places in Wigtownshire. When the sub-science of plant-ecology has taught us the full facts regarding the relationship existing between organism and enviroment, then shall we be able to generalise sets of phenomena regarding the geographical distribution of water plants to some useful purpose.

Whilst I have no desire to enter the contest with those who so boldly wield the cudgels in the arena of the origin of species, yet I may briefly state the impression regarding this subject which the study of the plants of the lochs has left upon me. In the first place, it seems to me that aquatic plants have not always had their origin from terrestrial forms that had been forced into the water by more robust competitors on the land, as is sometimes stated, but, more probably, because certain mutable forms have exhibited a tendency, as some do even now, to take on the aquatic habit, that mode of living being more agreeable to their requirements. Some plants form themselves into dense associations consisting of one species only, which spread over considerable areas, and not only prevent others from growing amongst them, but year by year extend their borders at the expense of neighbouring plants. In the vanguard of such colonies there is doubtless very keen competition for the space, and the weaker or less suitably adapted species will be slowly driven before the stronger. This, however, is unlikely to go on continuously, because the stronger species will sooner or later meet with physical or chemical barriers which it is ill adapted to overcome, but to which the weaker species may be better adapted. Quite commonly, it is not that competition for available space is so great, but that the local conditions favour the dominant growth of a few individual species. One frequently finds normal terrestrial or marsh species taking on the aquatic habit: instance Ranunculus Flammula, Juncus supinus, J. acutiflorus, Peplis Portula, etc., but always of their own free will, so to speak, *i.e.* by the exercise of the subtle power of adaptability which is more or less the common possession of all plants; never have I observed the case of a plant being driven into the water by a stronger competitor.

From another aspect of this interesting subject, it appears to me that other causes for variation, with the consequent production of new forms, lie in the fact that although the conditions for plant life are so often remote from the ideal, yet the plastic power possessed by plants, enabling them to adapt themselves to the various combinations of edaphic and climatic conditions, is so great that there are comparatively few spots, where existence is possible, in which some plant or other is not able to thrive and carry on its metabolic activities. Now in order to maintain a proper tone of health a plant has of necessity to respond in suitable ways to all the varying external impressions. A plant is therefore in a constant and continual state of change, owing to the never-ceasing mechanical, physical, and chemical changes of its unstable environment. The plastic nature of many plants enables them to modify their organs in reciprocation to any fairly constant set of environmental conditions, and it is in this endeavour to accommodate themselves for the maintenance of healthy existence in places that are either inhospitable or too luxurious, that certain deviations, either fixed or transient, from the usual forms of more normal environments are to be accounted for, and such variations occur in almost every loch. That some of such variants may doubtless be concerned in the origin of new species and varieties is the impression that I have received, but I hasten to add that other causes also contribute towards that process.

The rapid increase of aquatic and marsh plants in reservoirs that are used for the public water supply is occasionally a matter of anxiety and expense to the owners. Enormous sums of money are frequently paid by public bodies for advice respecting the construction of reservoirs to persons wholly unacquainted with the local geological features, as well as with the flora and fauna of the district. Whilst it is very unwise to construct a reservoir over a geological fault and expect it to hold water (and this has been done), it is equally vain to make a shallow reservoir in the line of the constant migration of water-fowl (*i.e.* between their resorts), and expect it to maintain a freedom from water plants. By consulting the table on pp. 97–99 it will be seen that the greatest depth at which aquatic plants will flourish in Scottish waters is about 40 feet. It is very unlikely, however, that the species capable of growing at such a depth will ever become a nuisance in a reservoir. But at a depth of 20 feet it will be found that, in suitable water, many species capable of giving trouble will flourish. Upon consideration of these facts, it seems advisable, as a prevention against the development of water plants, to construct reservoirs with sides so steep that a minimum depth of from 20 to 25 feet will be maintained within a few yards of the margin. Moreover, the sides, unless of natural rock, should be faced with stonework, which will further impede the growth of plants, as well as prevent discoloration of the water by wave-erosion.

The record of the field work that I have done on behalf of the Scottish Lake Survey is now completed, and I trust that the reader will receive from this contribution a share of the pleasure that its preparation has afforded me. It has always been my endeavour to describe as plainly as possible what I have learned

> "From the great lakes of the Northland,
> From the mountains, moors, and fen-lands."

To that end I hope the accompanying illustrations will immediately convey more perfect ideas of the subjects they represent than could be obtained from tedious verbal descriptions.

The lochs mentioned in this paper may be found in Bartholomew's half-inch maps of Scotland, numbers 1, 2, 4, 8, and 13.

An account of the physical and biological features, together with bathymetrical maps on a large scale, of most of the lochs enumerated in the two parts of this contribution, will be found in a series of volumes on the Fresh-water Lochs of Scotland, now being prepared by Sir John Murray. In the same publication the reader will also find an epitome of the work that I have done, together with some remarks and illustrations not previously published.

In conclusion, I wish to acknowledge with gratitude my indebtedness to Sir John Murray and Mr Laurence Pullar for the help and kindly encouragement which they have at all times given me.

University College,
Dundee.

(*Issued separately January* 12, 1910.)

"——The greatest thing a human soul ever does in this world is to see something and tell what it saw in a plain way."—RUSKIN.

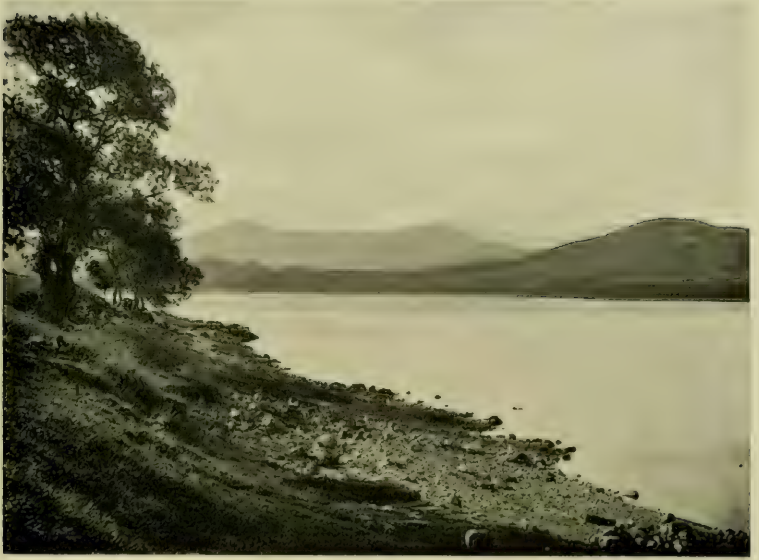

Fig. 1.—View of the south end of Loch Doon from Portmark, looking towards Merrick, which is the most distant mountain in the centre of the picture; that in the distance on the left is Mullwharchar. The barren stony shore merging into moor is clearly shown.

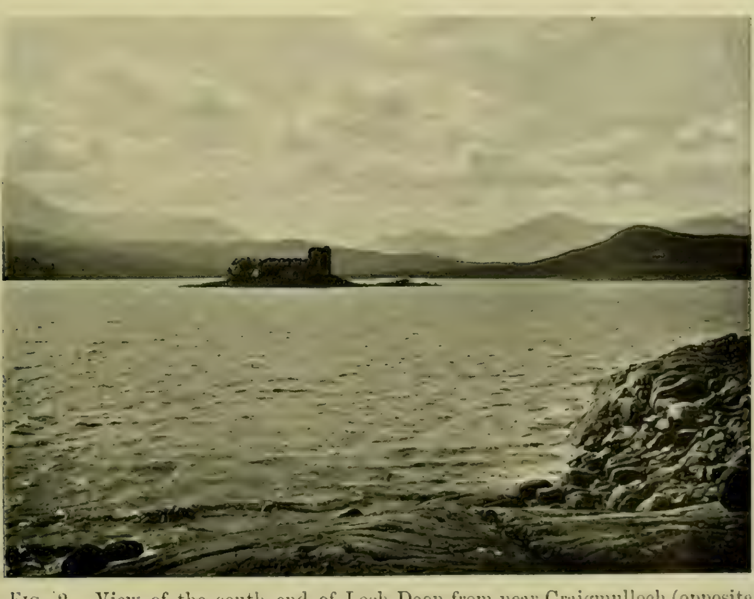

Fig. 2.—View of the south end of Loch Doon from near Craigmulloch (opposite Portmark), showing the rocky shore, Castle Island, etc. The highest distant mountains are Mullwharchar on the right and Meikle Craigtarson on the left; between them runs the glen leading to Loch Dee.

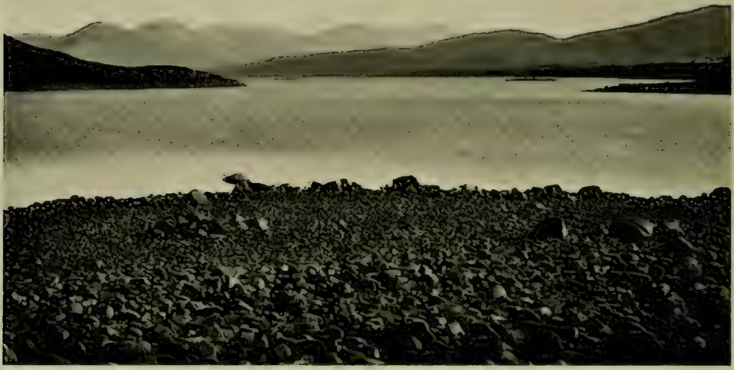

Fig. 3.—View from the north end of Loch Doon looking south-east, showing bare stony shore and evidences of glaciation on the land Only a portion of the loch can be seen from this point, owing to its curvature. It runs parallel to the distant hills, of which the one on the right centre of the picture is Coran of Portmark.

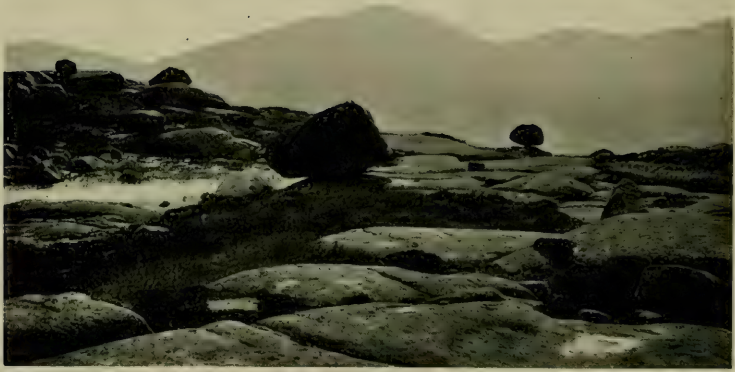

Fig. 4.—The top of Craiglee, looking towards Curleywee, the distant mountain in centre of picture, showing bare, rocky mountain-top, with numerous perched rocks. The pool on the left has a few dwarf specimens of Juncus, Carex, Eriophorum, etc.

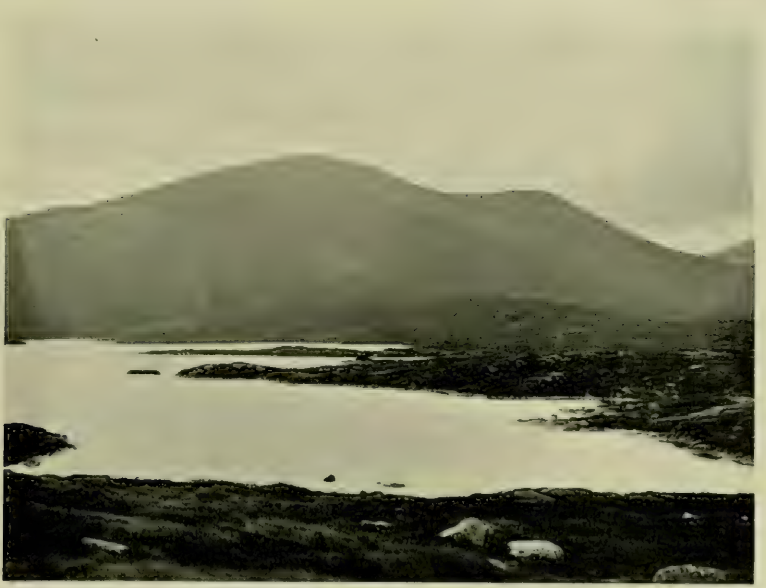

Fig. 5.—Loch Enoch and Merrick, view from the north-east shore looking west. The outline is very irregular, and the rocky shore supports but few Phanerogams.

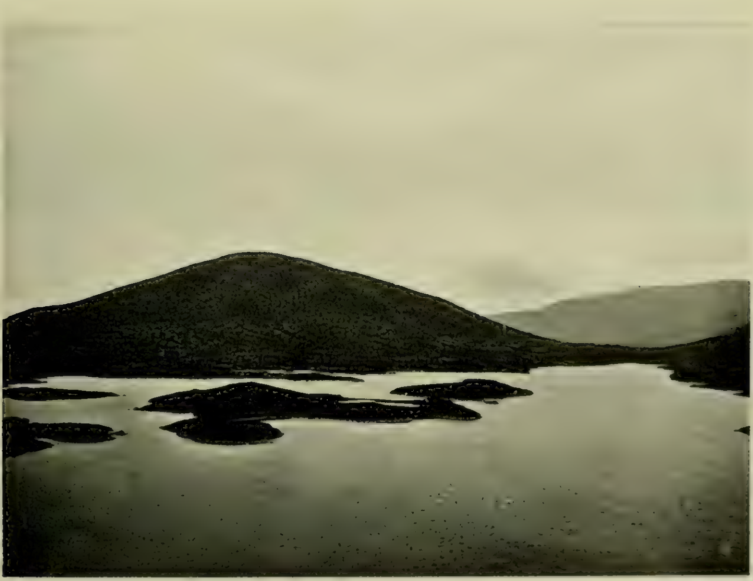

Fig. 6.—Loch Enoch and Mullwharchar, view from the south-west shore looking north-east. The largest island has upon it a little loch. The distant hill on the right is Carlin's Cairn, upon the opposite side of the glen.

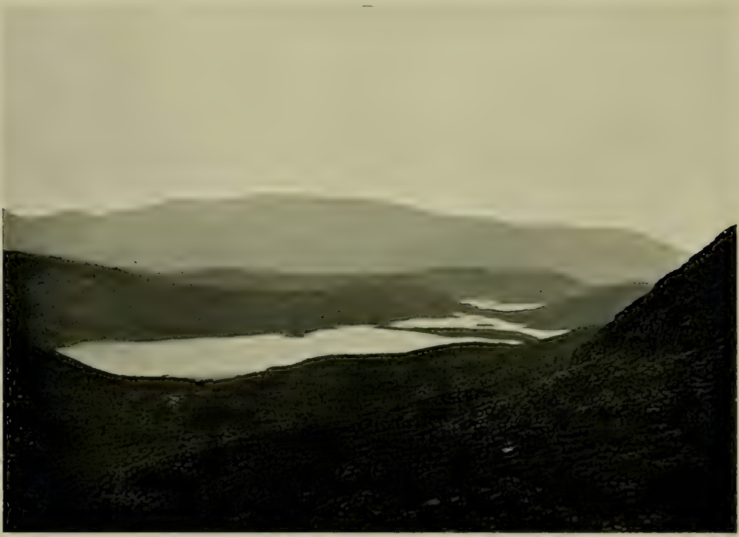

Fig. 7.—View from the Nick of the Dungeon looking south, showing Lochs Neldricken and Valley. The distant hills are Lamachan and Larg. The portion of Loch Neldricken shown in fig. 8 is the arm to the right of the picture, partially hidden by the hill in the foreground.

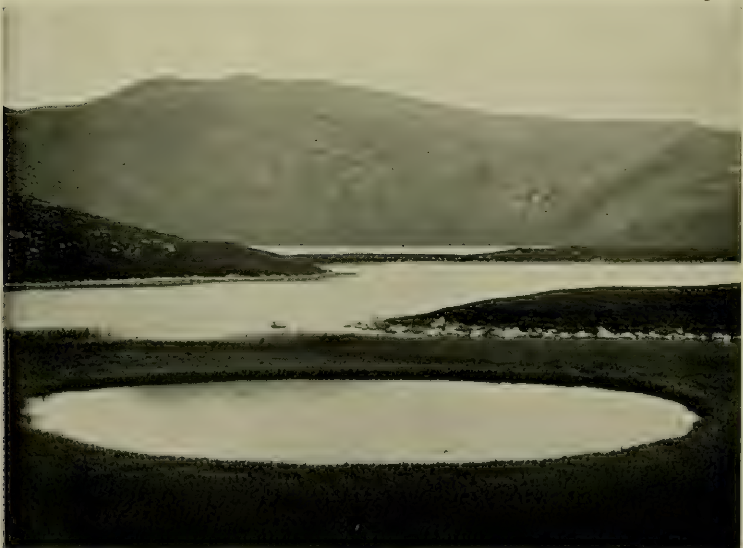

Fig. 8.—Loch Neldricken, view from the north-west corner, looking east towards Craignaw, showing in the foreground a very regularly shaped "murder-hole."

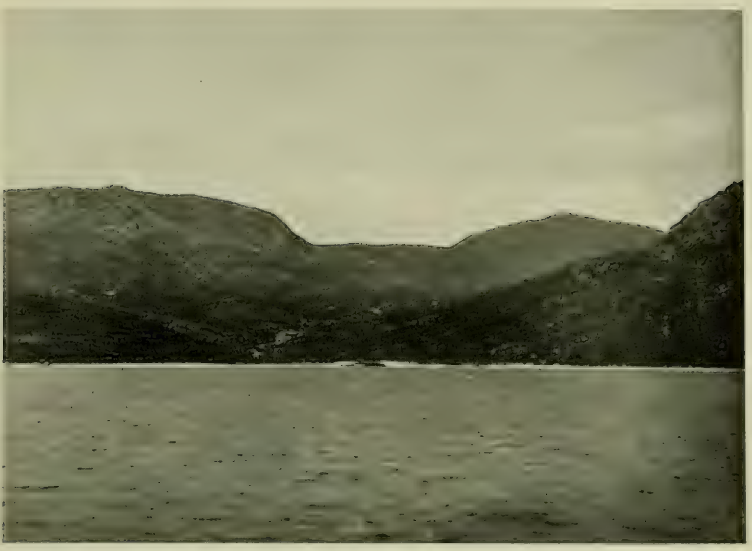

Fig. 9.—Loch Neldricken from the south shore looking north, showing extensive shore of white sand; at the head of the glen in the centre of the picture is seen the Nick of the Dungeon, which joins Dungeon Hill with Craignaw.

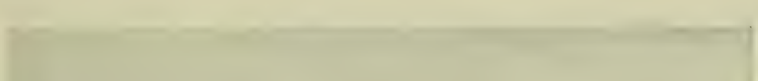

Fig. 10.—Loch Valley, looking west from a shoulder of Craignaw, showing rocky shore and white sandy bays, almost bare of vegetation. Buchan Hill is seen at the end of the loch, below which flows the Gairland Burn that drains Loch Valley into Loch Trool.

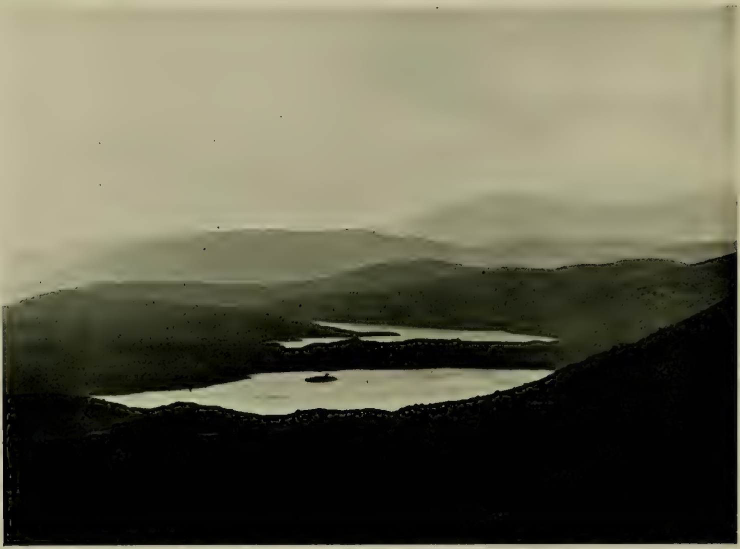

Fig. 11.—Round Loch of Glenhead and Long Loch of Glenhead, from a shoulder of Craiglee. The marginal flora of the lochs is very sparse, whilst that of the adjacent moor is principally of grass or heather associations. The distant mountain on the right centre is Benyellary.

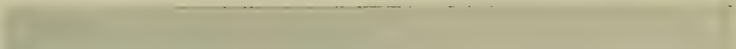

Fig. 12.—Loch Dee, with Craiglee rising from its north-west shore. On the right is seen a portion of the Kells Range, between which and Craiglee runs the glen leading to Loch Doon (10 miles). The White Laggan Burn, meandering through the foreground, enters Loch Dee at its south corner.

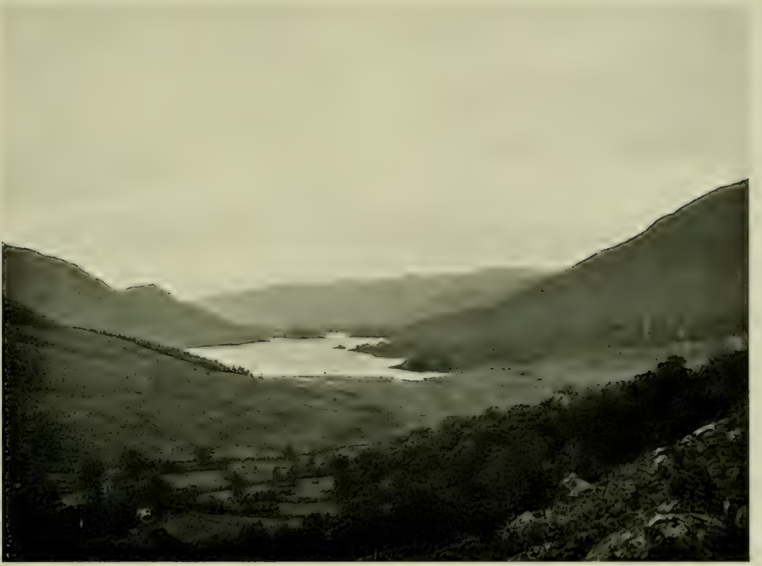

Fig. 13.—Loch Trool, from the hillside above Glenhead, looking west. Half-way down the loch, wooded promontories project into the water from either side, leaving but a narrow passage; this is seen from the other side in figs. 14 and 15.

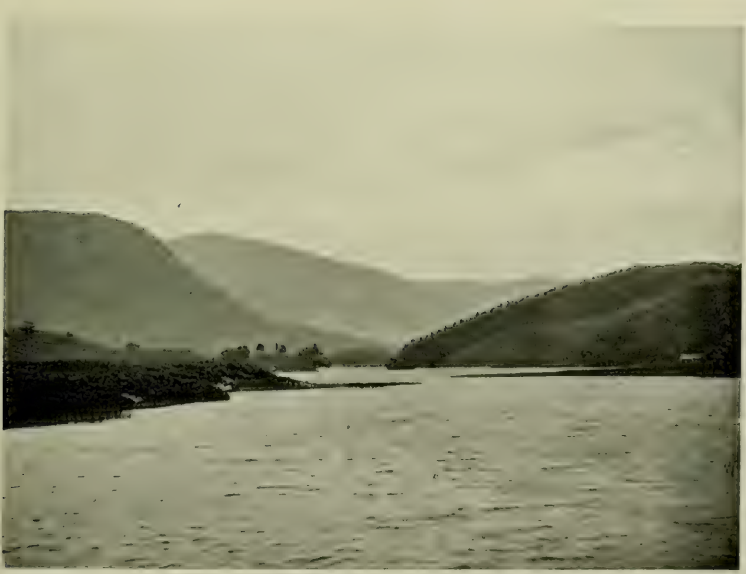

Fig. 14.—Loch Trool from the west end, looking east. Associations of Carex rostrata, etc. occur about the margin. The greater portion of the loch is hidden from view by the promontories mentioned above.

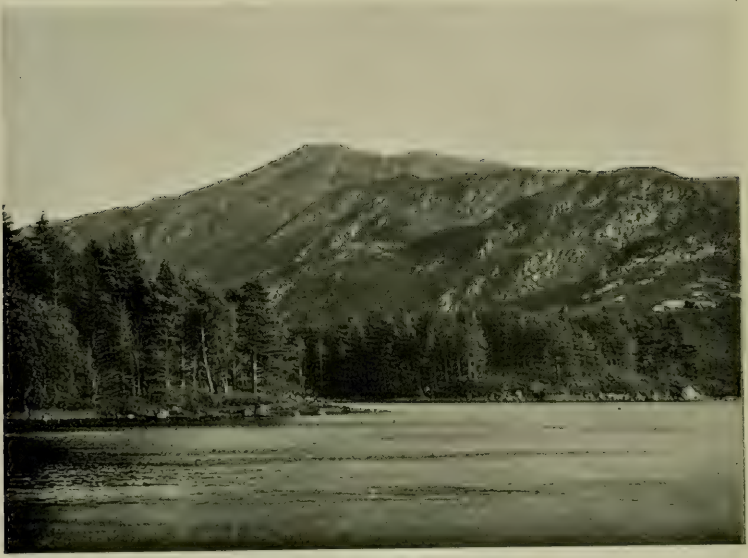

FIG. 15.—Loch Trool. View from the Earl of Galloway's boat-house, looking across the loch. The narrow channel formed by the two wooded promontories (see also figs. 13 and 14) is indicated at the left centre of picture. The narrow zone of rocky shore is very bare of littoral plants.

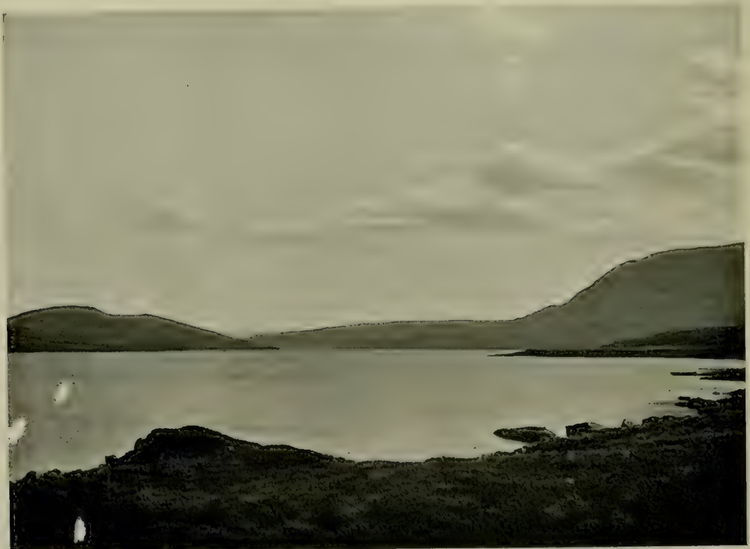

FIG. 16.—Loch Grennoch (by Cairnsmore of Fleet). View from the north-west end, looking south. The sandy bays are not well shown as the scale is so small. This wind-exposed loch has scarcely any littoral vegetation.

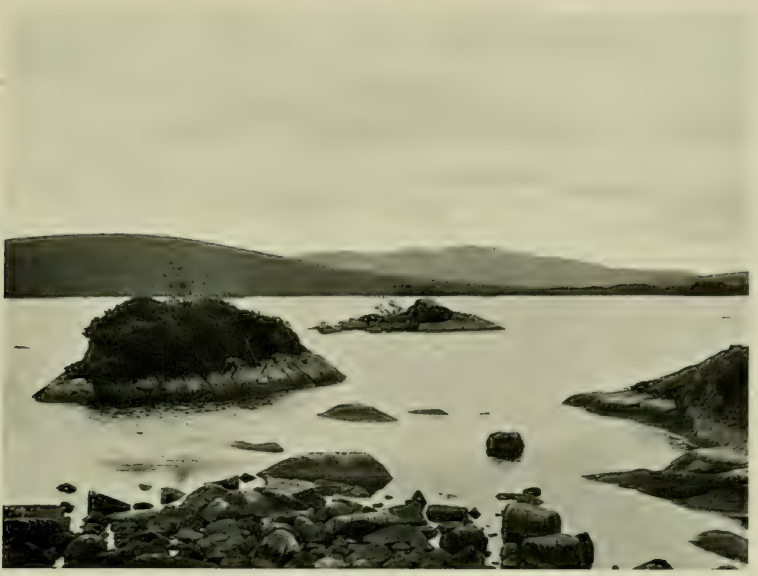

FIG. 17.—Loch Skerrow. View from the east side, looking south-west, showing rocky shore, island-rocks capped with Calluna, Vaccinium, etc.; there are larger islands with dwarf trees at the other side of the loch.

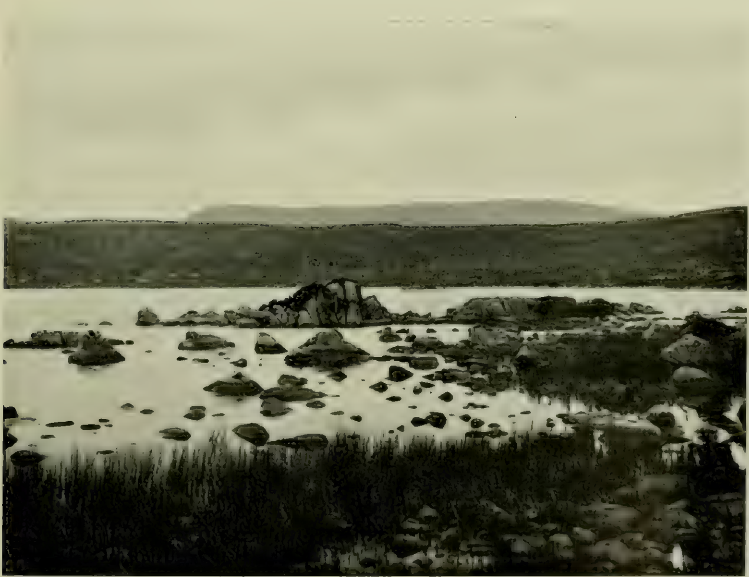

FIG. 18.—Loch Skerrow. View from the east side, looking north-west, showing rocky shore, which in the foreground is overgrown with Juncus lamprocarpus, Ranunculus Flammula, etc.

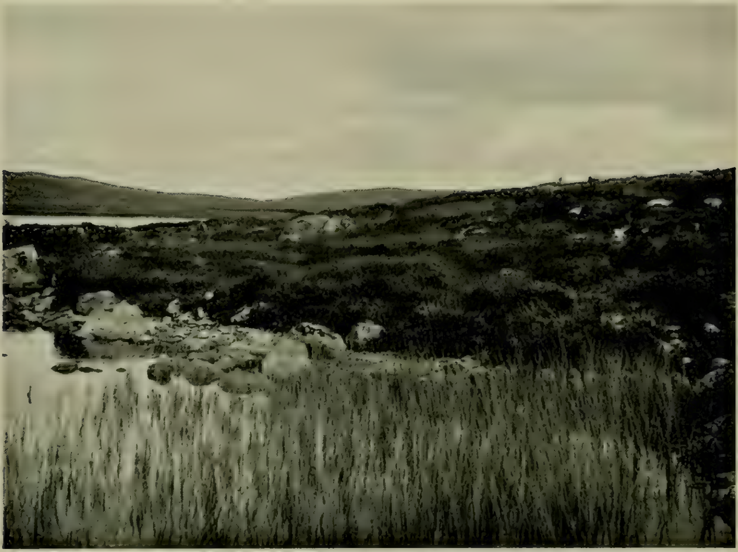

Fig. 19.—Loch Skerrow. A small bay on the west side, overgrown with Carex filiformis.

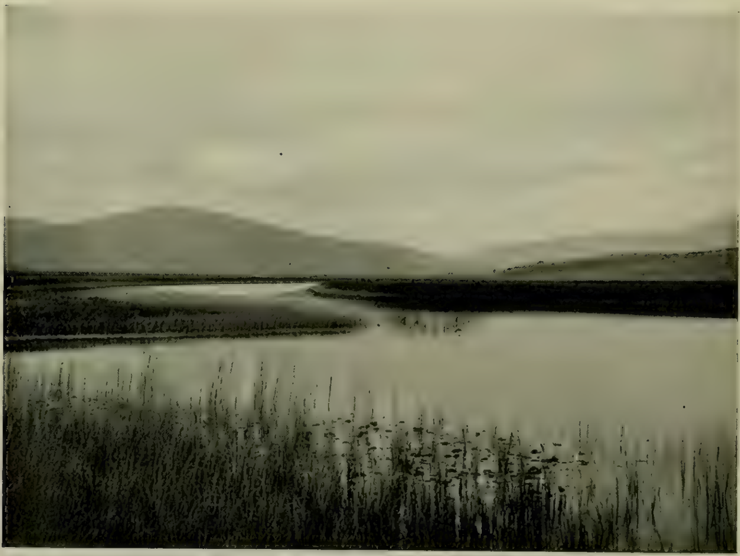

Fig. 20.—View looking north-west up the River Dee, at its junction with the Airie Burn, whose embouchure is on the left. A zone of Carex rostrata borders the river on either side; outside this zone, in the foreground, is Castalia speciosa, mixed with scattered Equisetum limosum and Scirpus lacustris.

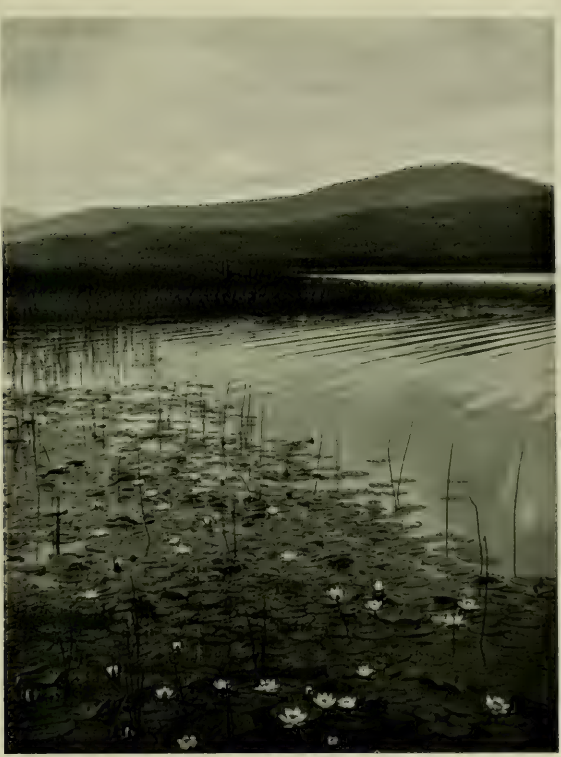

Fig. 21.—Another view of the vegetation bordering the river, from a position close to that of fig. 20, showing the zone of Castalia speciosa, amongst which are a few stems of Equisetum limosum and Scirpus lacustris; beyond this zone, Carex rostrata appears as in the preceding picture.

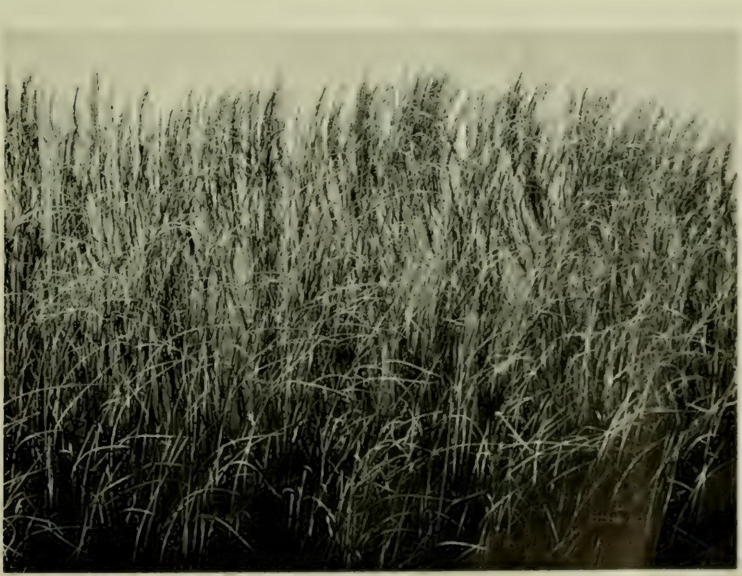

Fig. 22.—A view looking into the zone of Carex rostrata which borders the river, as shown in the two preceding figures.

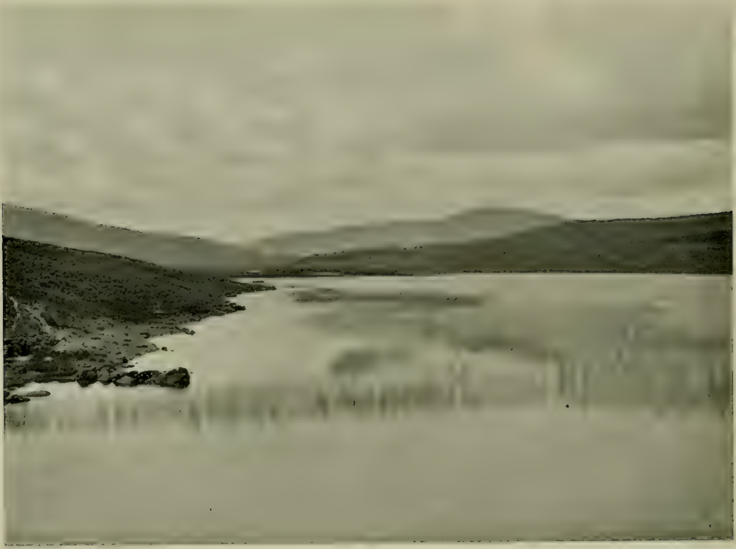

Fig. 23.—Loch Stroan from the south-east corner, looking north-west, showing Scirpus lacustris bordering the stony shore, River Dee in the distance, etc.

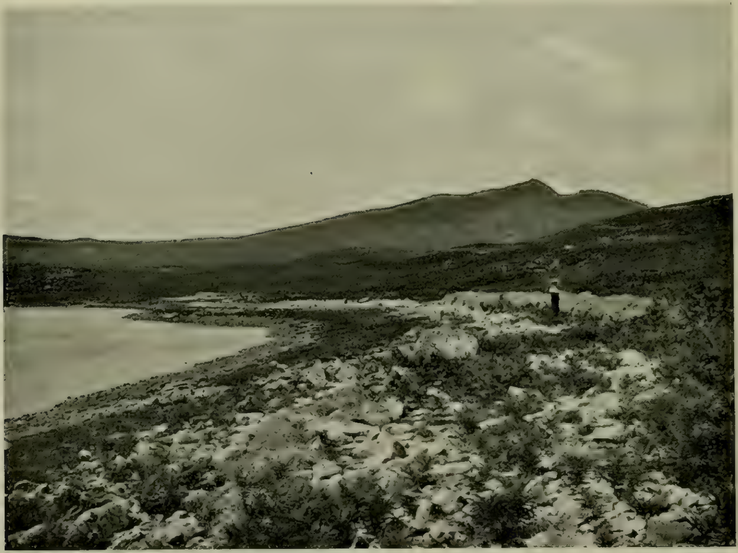

Fig. 24.—Loch Stroan. East shore, showing its rocky nature and a bank of vegetable remains, to which the man is pointing, washed into its present position by winter floods. The moor is clothed with associations of grass, bracken, and heather, but a deal of bare rock appears; stragglers from these associations occur upon the shore.

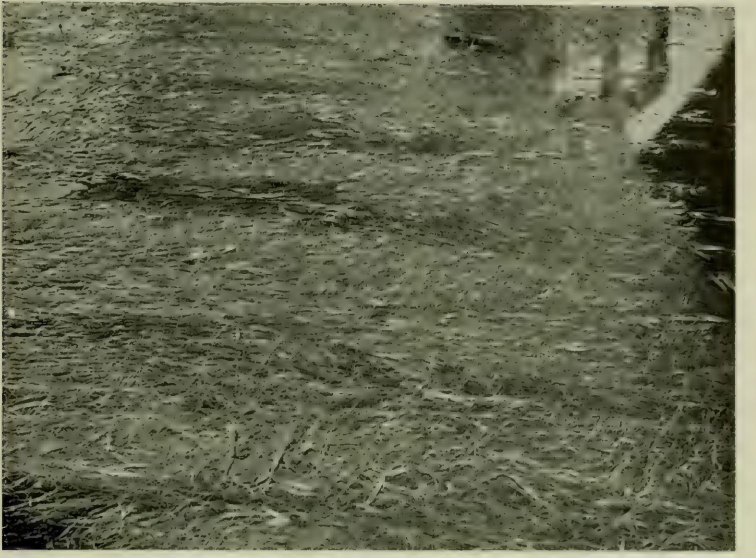

Fig. 25.—Loch Stroan. Scirpus fluitans floating on the surface of the water.

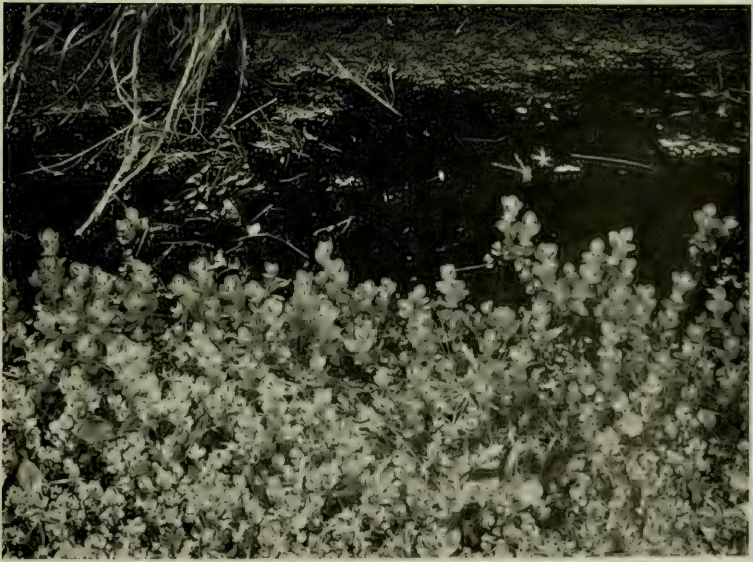

Fig. 26.—Loch Stroan. Hypericum elodes, not yet in flower, growing in a peaty pool.

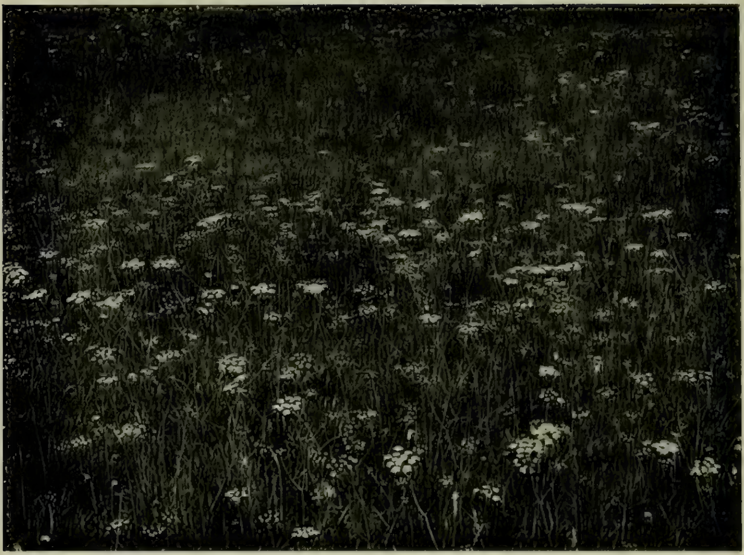

Fig. 27.—Loch Stroan. Carum verticillatum growing amongst other herbage in marshy ground. A characteristic marsh plant in the Galloway district.

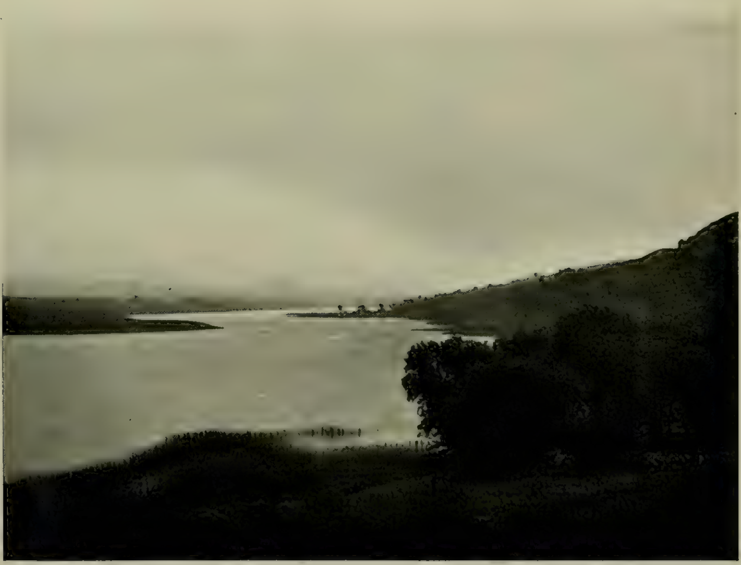

Fig. 28.—Woodhall Loch from the north-west end, looking towards Laurieston. The sides of the hill on the right are covered with mixed wood, and an association of Scirpus lacustris occurs in the foreground.

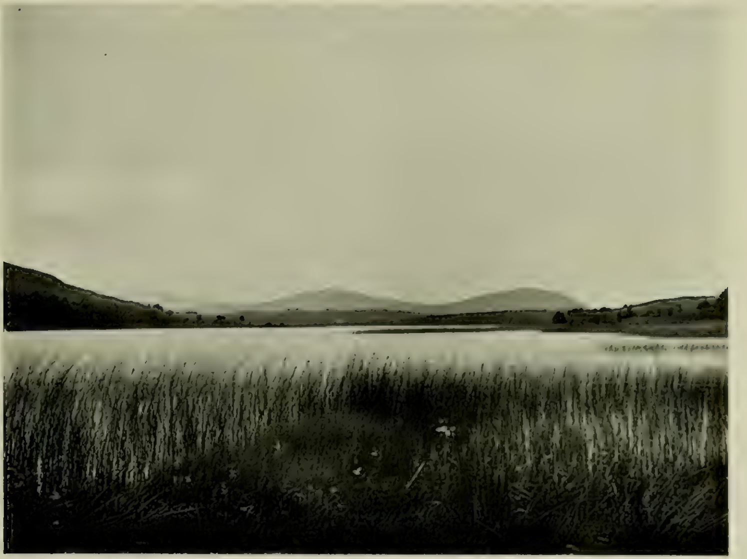

Fig. 29.—Woodhall Loch, from south-east to north-west, showing Scirpus lacustris bordering the loch. The wooded hill on the left is a continuation of that seen in fig. 28.

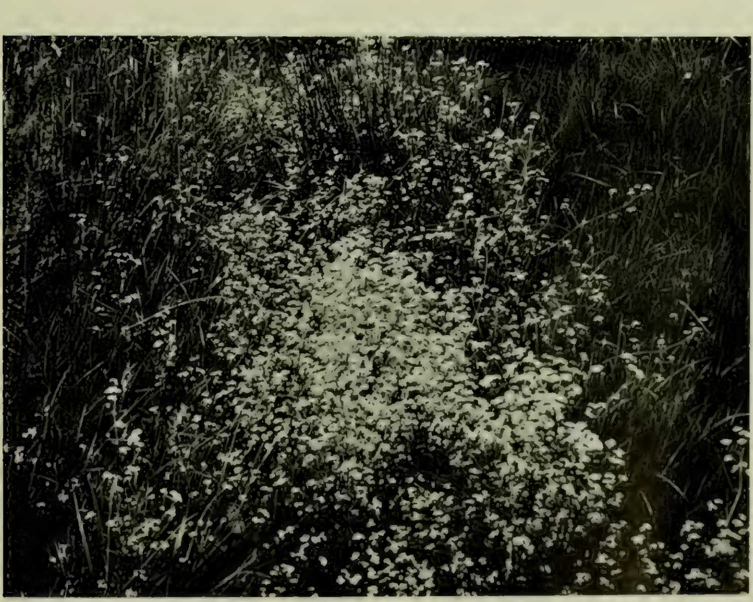

Fig. 30.—Galium palustre, growing amongst Carex and Juncus. This scrambling marsh plant is particularly abundant at some of the lochs of Galloway.

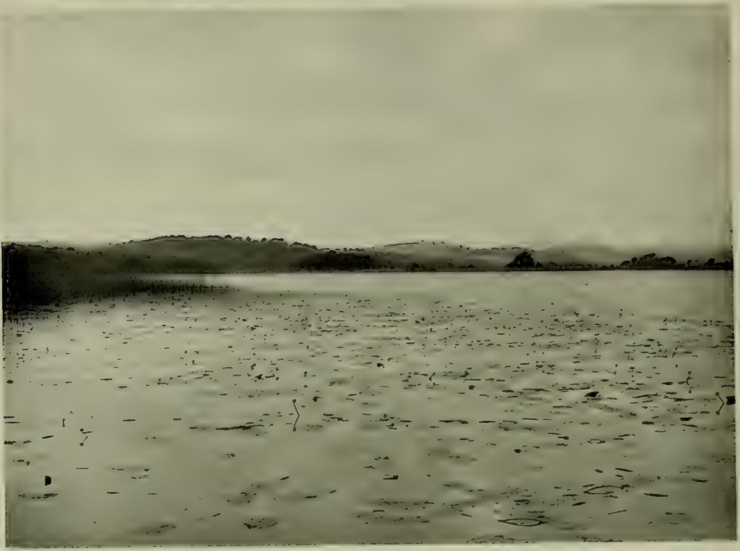

Fig. 31.—Loch Ken. View near New Galloway from the west shore, looking north, showing a large association of Nymphæa lutea extending along the loch for about a quarter of a mile outside a zone of Scirpus lacustris. The water over the Nymphæa area is from 2 to 7 feet deep.

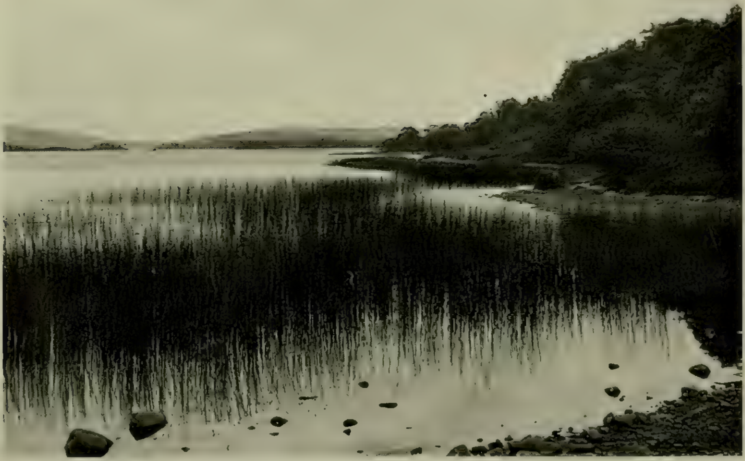

Fig. 32.—Loch Ken. View from the west shore, looking south-east, with Burned Island and Green Island in the distance, showing a zone of Scirpus lacustris skirting the shore.

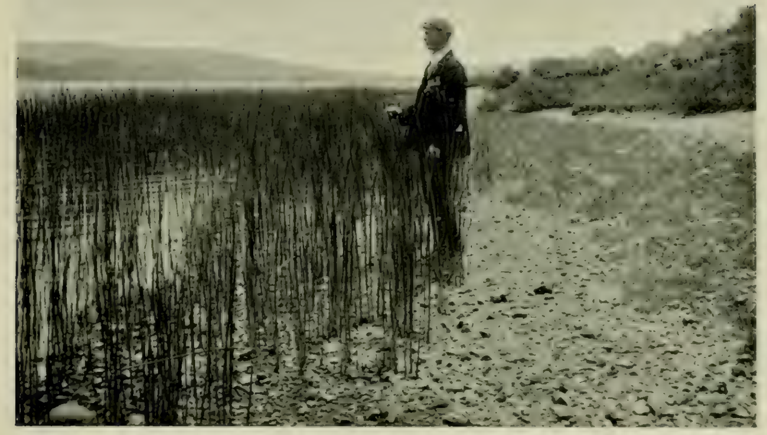

Fig. 33.—Loch Ken. View on the west side, looking south-east, showing Scirpus lacustris growing upon the dry shore 3 or 4 feet high, the water having receded somewhat through drought.

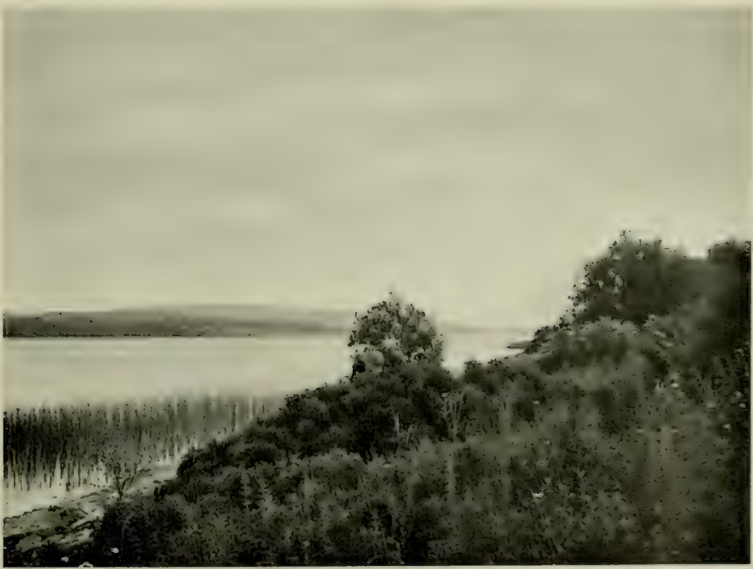

Fig. 34.—Loch Ken. View from the west shore 2 miles from the head of the loch, looking south-east, showing Scirpus lacustris growing out of the water, and the bush association of the littoral, of which Myrica Gale, here about 5 feet high, is dominant; the taller bushes are Alnus glutinosa. Cnicus palustris, Œnanthe crocata, ferns and other herbaceous plants are mixed with the bush.

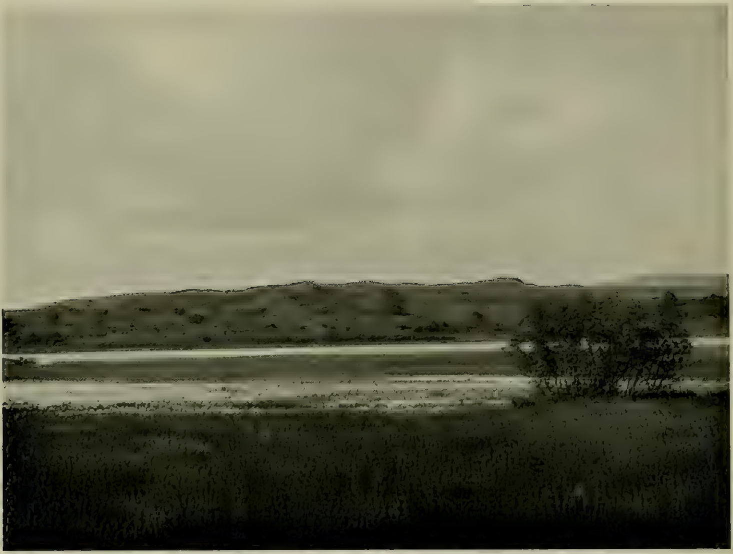

Fig. 35.—Loch Ken. View from the west side about 1½ miles north of the viaduct, looking east across the loch, showing gradual change from terrestrial to semi-aquatic vegetation. In the foreground there are various grasses, with Juncus effusus, then a wide zone of Eriophorum polystachion, beyond which are associations of Carex rostrata, Menyanthes trifoliata, Heleocharis palustris, etc., whilst out in the water a belt of Scirpus lacustris extends along the loch.

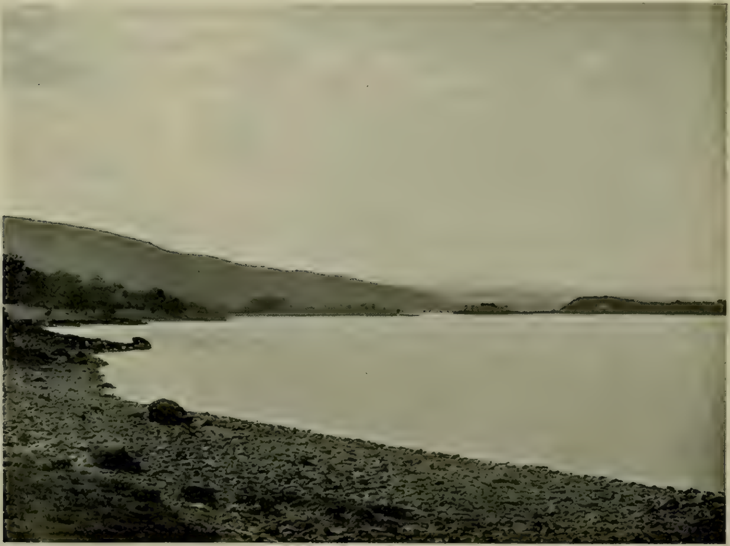

Fig. 36.—Loch Ken. View along the west shore about a mile north of the viaduct, looking towards the islands. The shore is here stony and almost bare of vegetation.

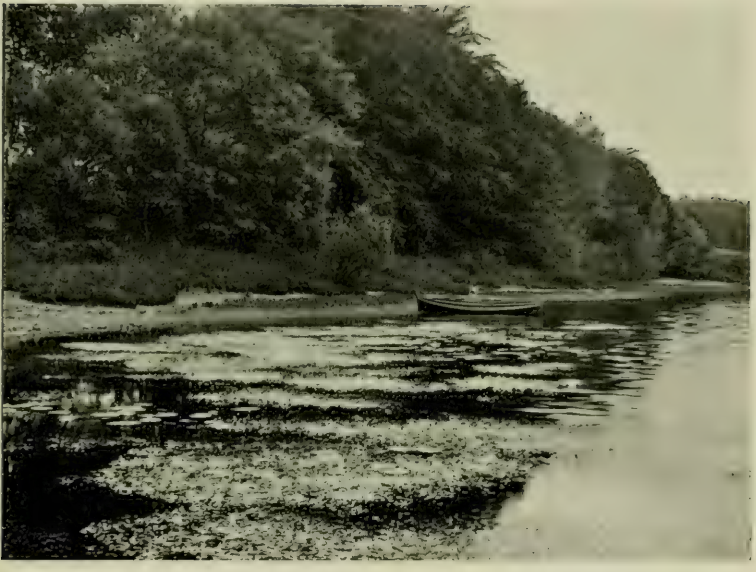

Fig. 37.—Loch Ken. View along the east side near the viaduct, showing the wooded shore and Ranunculus heterophyllus flowering upon the surface of the water, and extending over a considerable area ; a few specimens of Nymphæa intermedia are seen on the left.

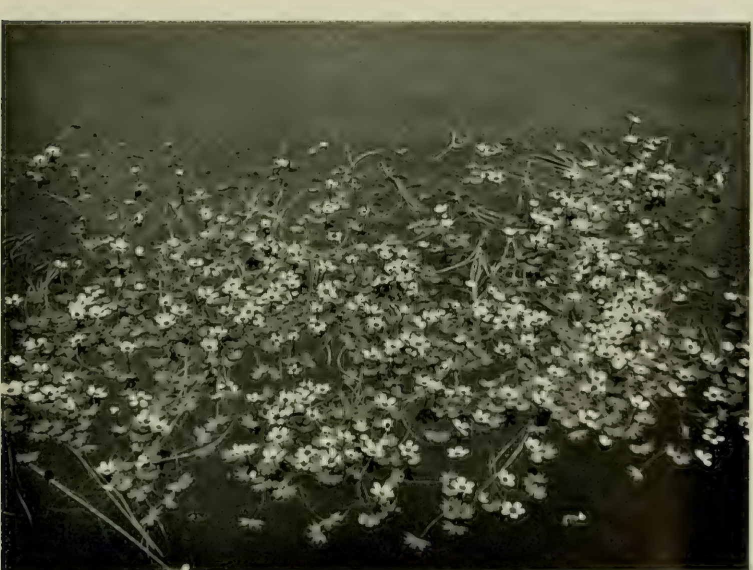

Fig. 38.—A closer view of a portion of the association of Ranunculus heterophyllus shown in fig. 37.

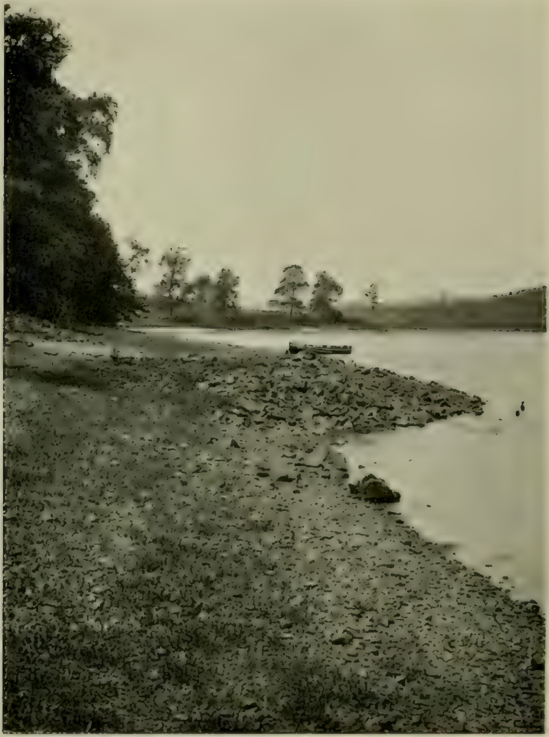

Fig. 39.—View on the west shore of Loch Ken, showing a dwarf prostrate form of Ranunculus Flammula (larger than var. pseudo-reptans) overgrowing the stony beach.

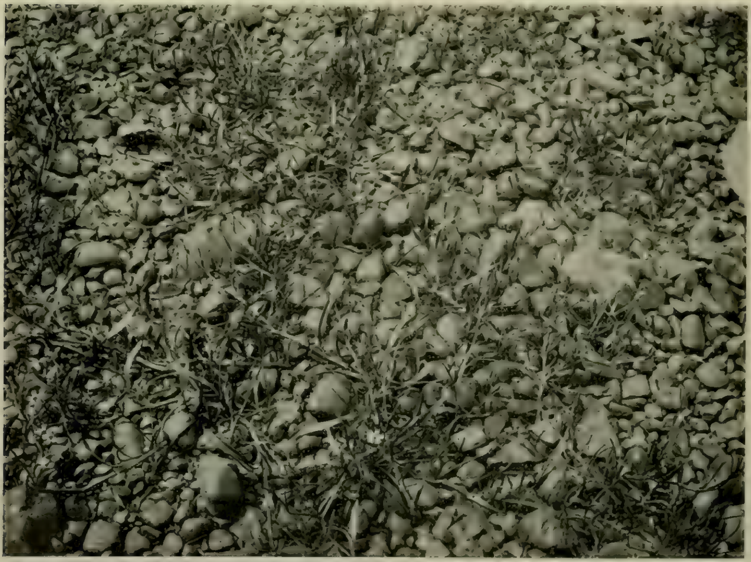

Fig. 40.—A nearer view of a portion of the beach shown in fig. 39, showing the plants more distinctly. The dull green colour of the plants and the grey stones are not sufficiently contrasted in the photograph.

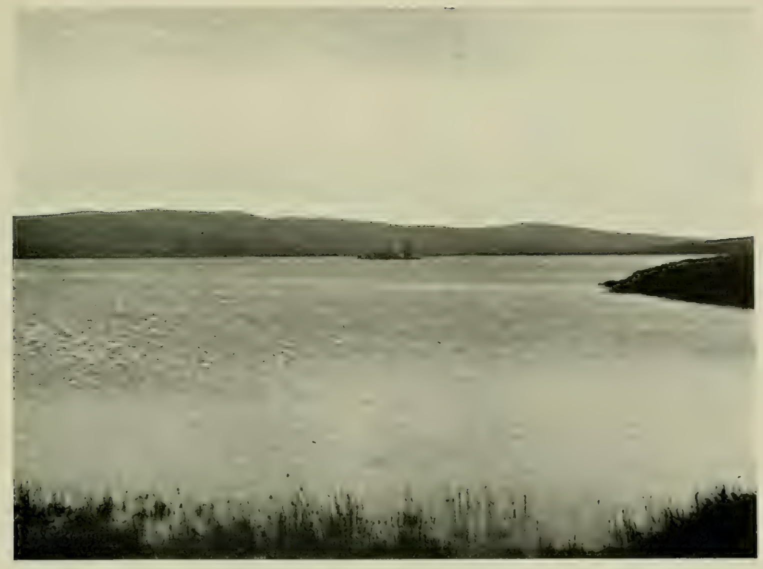

Fig. 41.—Lochinvar, showing the island on which there is a ruined castle, moorland vegetation approaching to the water's edge, so that there is no shore, and the treeless scenery around.

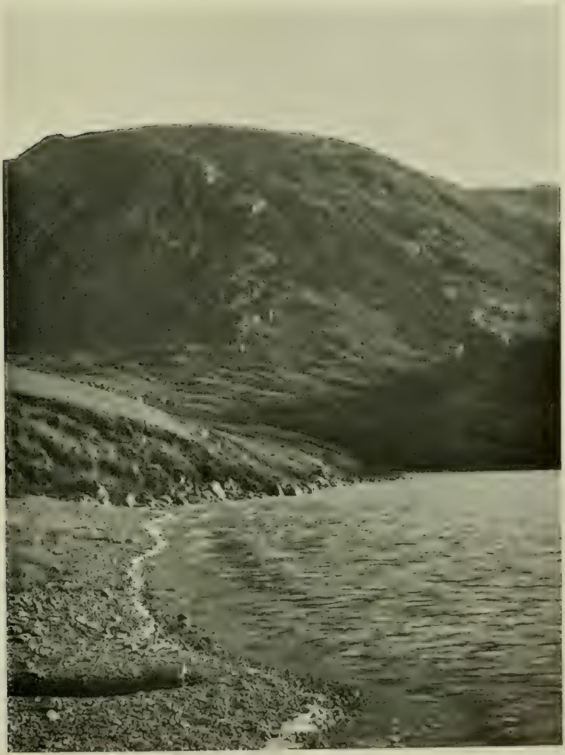

Fig. 42.—Loch Dungeon. View from the east side looking south, showing stony shore in the foreground, beyond which the littoral is very rocky, and the north flank of Meikle Millyea rising precipitously from the south shore.

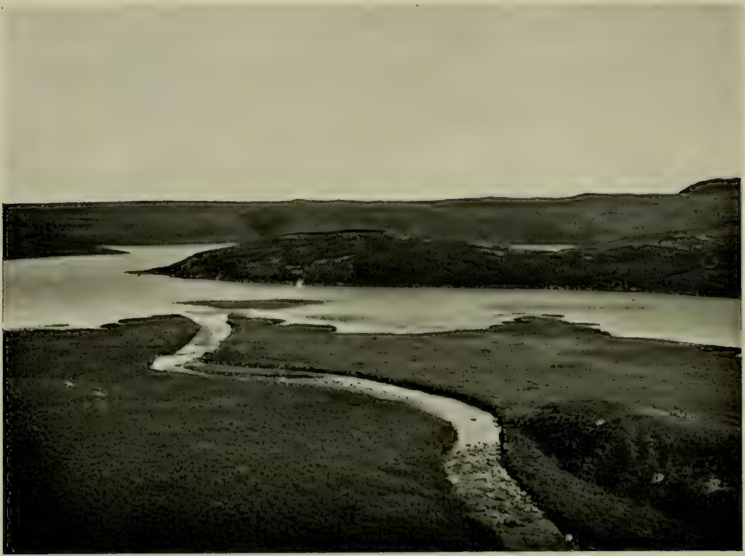

FIG. 43.—Loch Dungeon from the north-west side, looking east, showing the burn from the North Garry top entering the loch. The flat foreground on either side of the burn is an alluvial cone, and consists of detrital gravel from a large moraine through which the burn has cut its way. Previous to this reduction there must have been another loch of considerable extent, because the moraine formed a dam across the glen through which the burn flows.

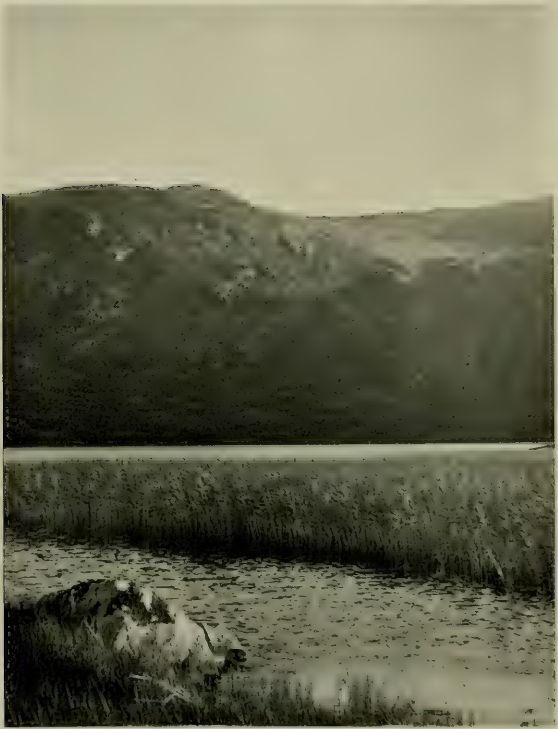

FIG. 44.—Loch Dungeon from the north-east corner, looking south towards Meikle Millyea, showing the large association of Phragmites communis at this corner of the loch.

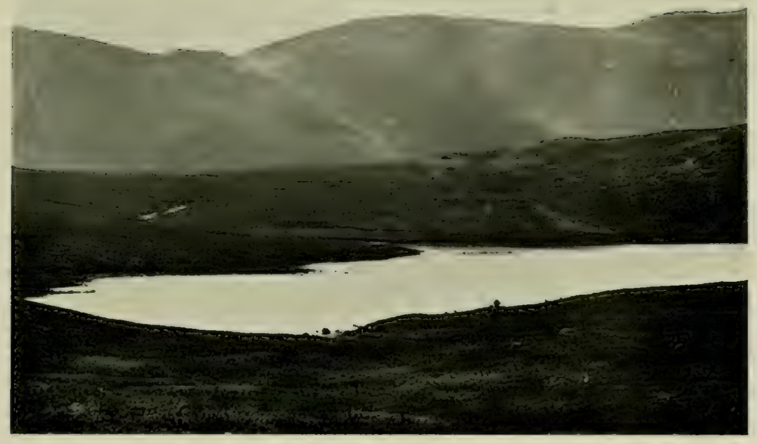

FIG. 45.—Loch Minnoch from the north-east, looking towards Loch Dungeon, showing the affluent and its fan of detrital matter covered with vegetation, as described in the text.

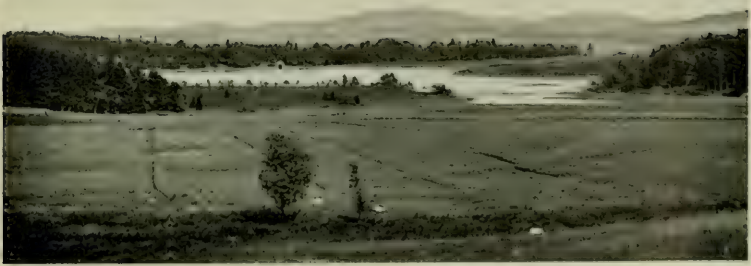

FIG. 46.—Loch Corsock. General view from the south-west, looking north-east, showing coniferous wood about the margin of the loch, and an extensive marsh in the foreground.

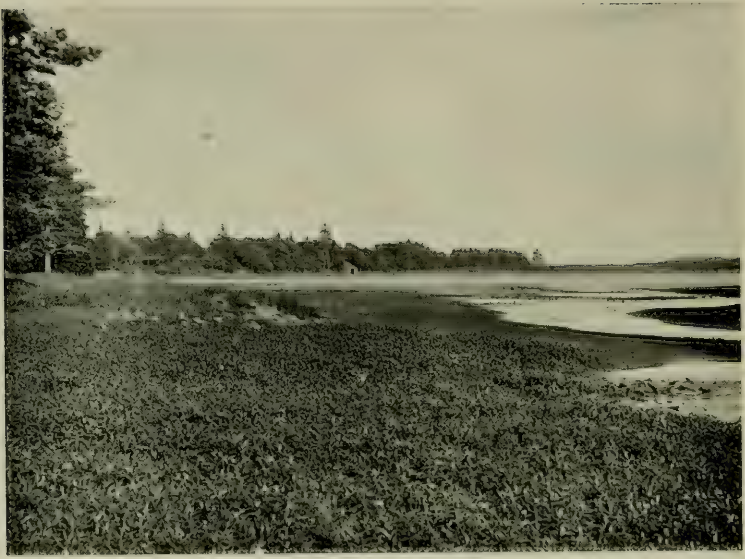

FIG. 47.—Loch Corsock. View from the north-west corner, looking east, showing the shore, exposed through drought, covered in the foreground with Polygonum amphibium.

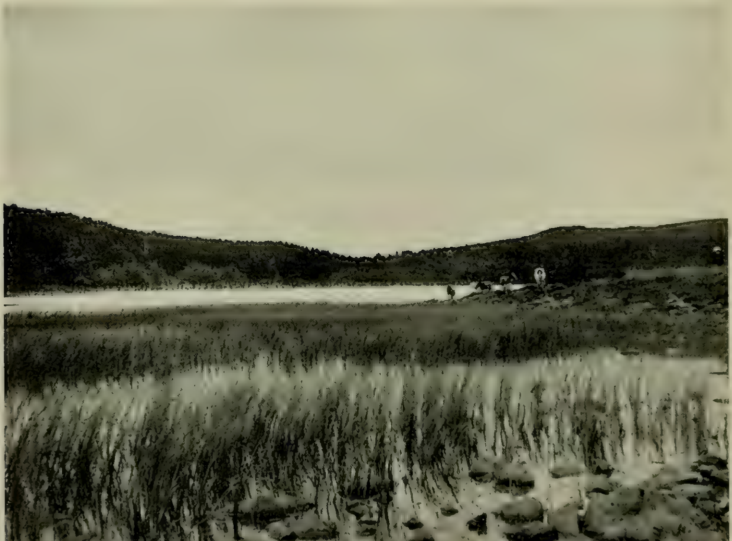

FIG. 48.—Loch Roan. View from the south-west, looking north-east, showing the plantation which surrounds the loch, excepting on the south side. The arm of the loch in the foreground is overgrown with Carex rostrata.

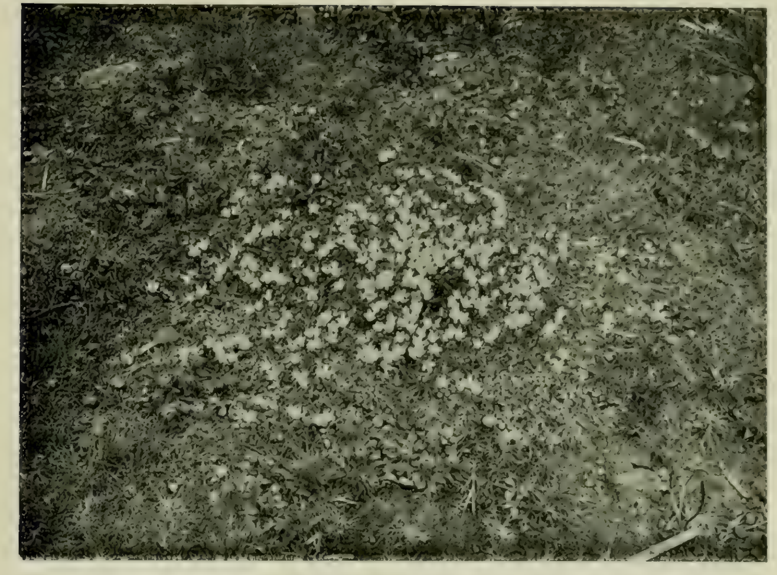

Fig. 49.—Loch Roan. A patch of Anagallis tenella on the west shore.

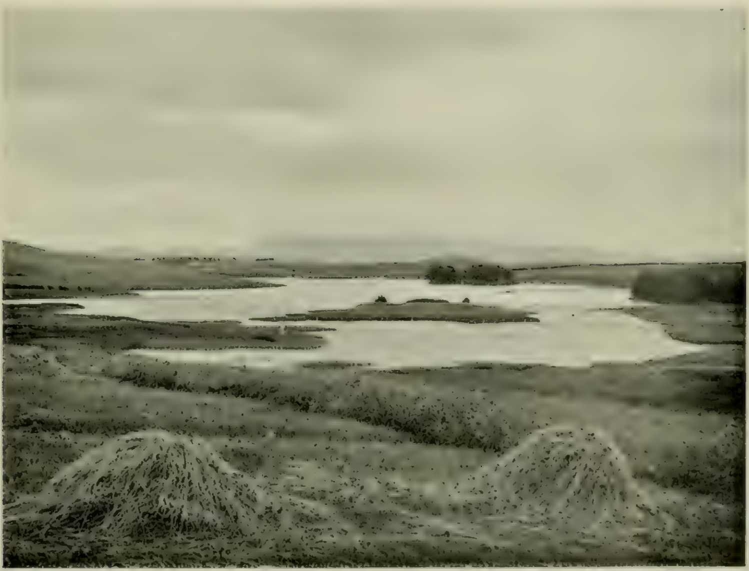

Fig. 50.—Loch Ernerogo from the north end, looking south-south-east, showing the swampy margin. Beyond the beds of Carex rostrata the shallower portions of the loch are overgrown with Castalia speciosa and Nymphæa lutea.

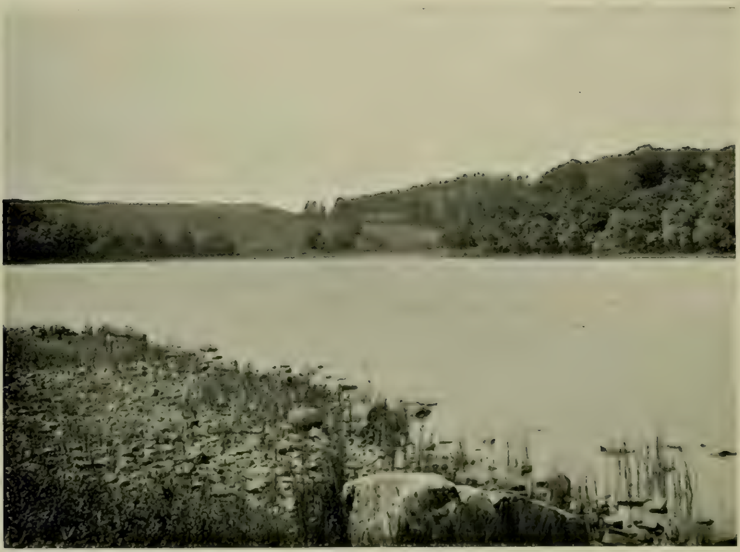

Fig. 51.—Loch Dornell. View from the south-east side, looking north, showing the stony shore overgrown with Juncus articulatus and Ranunculus Flammula, and the mixed wood upon the north side of the loch.

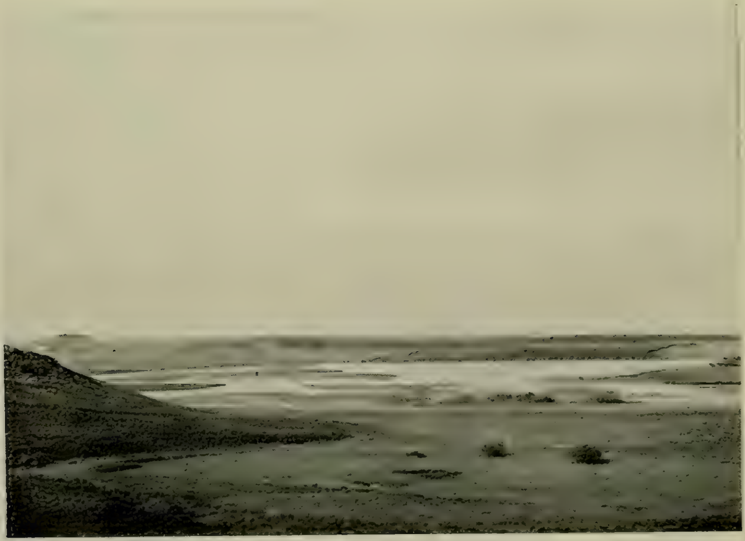

Fig. 52.—Loch Glentoo. View from the south-west, looking north-east, showing half the loch overgrown with Phragmites communis, Scirpus lacustris, Carex rostrata, etc.

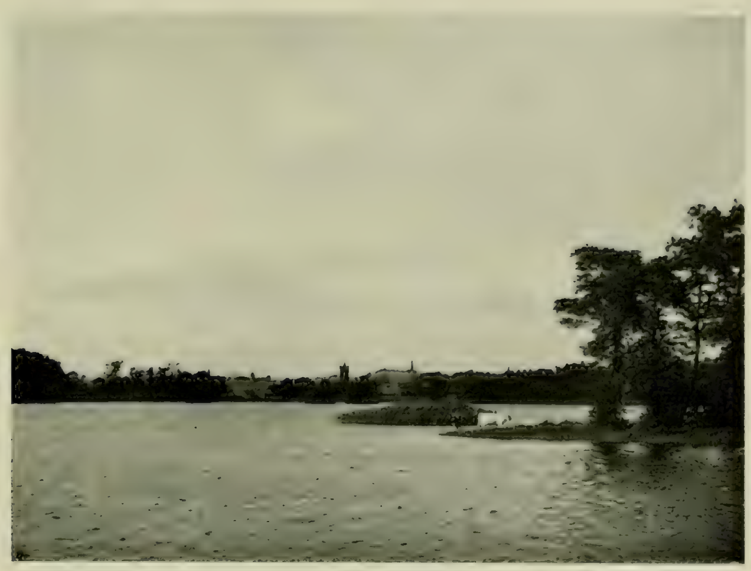

Fig. 53.—Carlingwark Loch. View from the east shore, looking north-west towards Castle-Douglas.

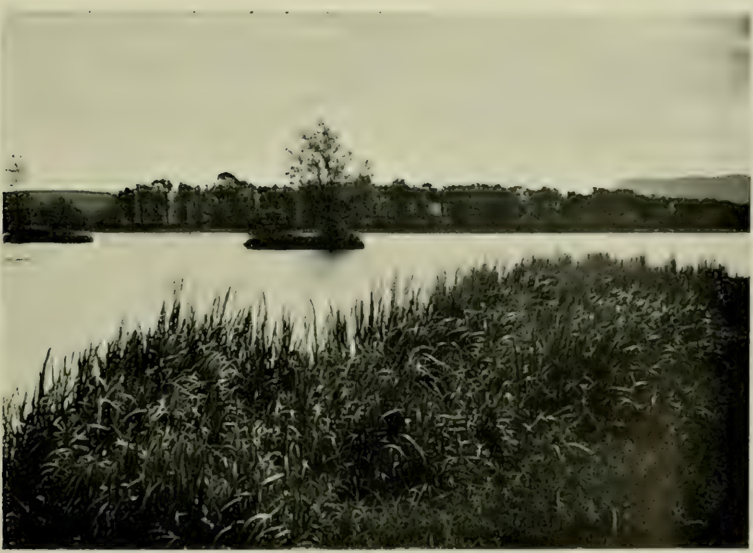

Fig. 54.—Carlingwark Loch, showing Glyceria aquatica upon the west shore, two of the islands with trees, and a strip of deciduous wood upon the opposite shore.

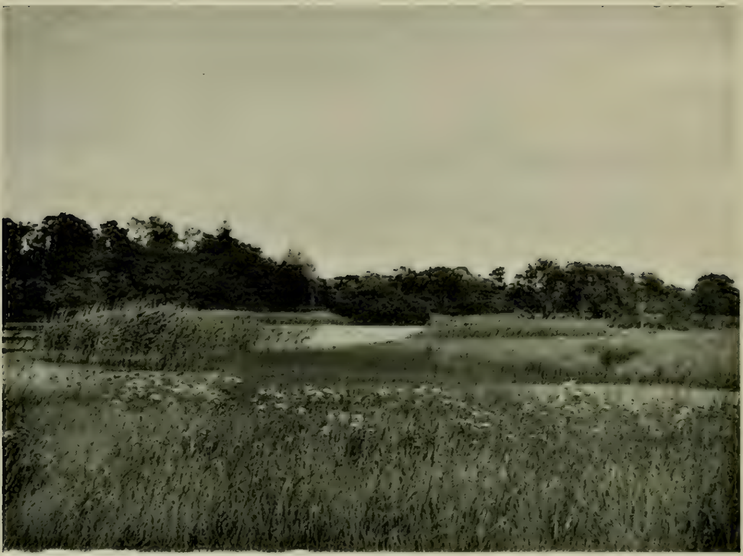

Fig. 55.—Carlingwark Loch. View at the south end, looking east along the margin, which is here a wide marsh, showing luxuriant vegetation in the following order from the foreground:—Carex rostrata, Ranunculus Lingua, Cicuta virosa, Equisetum limosum, a narrow arm of water with Nymphæa lutea, then a large area of Carex rostrata with a small association of Phragmites to the left of it, and Typha latifolia near the trees in the distance.

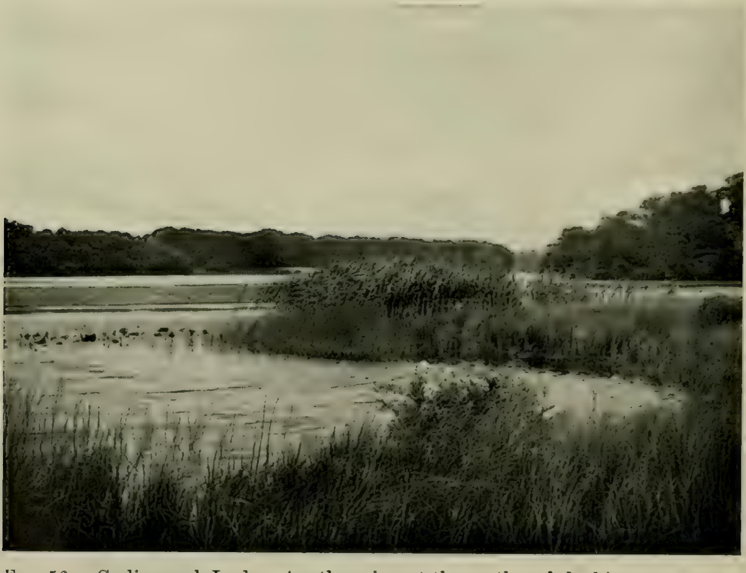

Fig. 56.—Carlingwark Loch. Another view at the south end, looking east, showing Carex rostrata in the foreground, with a group of Cicuta virosa at the margin of the water, beyond which are Equisetum limosum and Phragmites communis, with Nymphæa lutea in the water and deciduous trees in the distance.

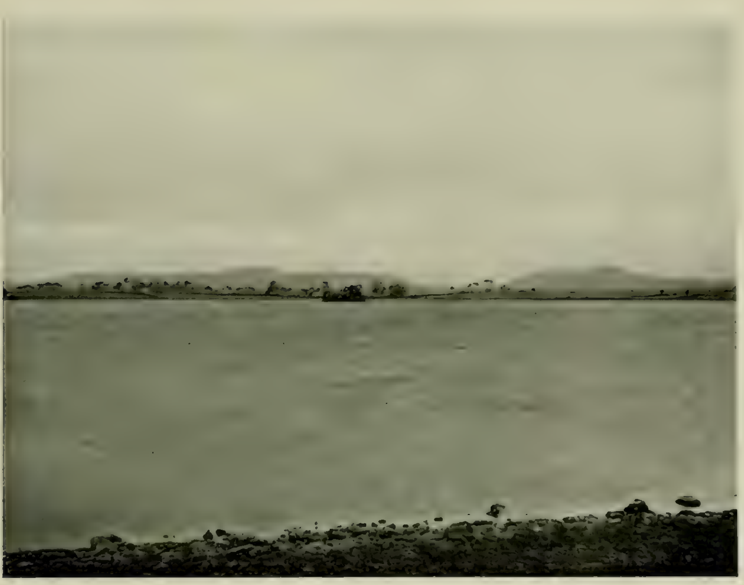

Fig. 57.—Lochrutton Loch. View from the south-east shore, looking north, showing an island with dwarf trees in the middle of the loch, and the village of Lochfoot at the north end. The open and wind-exposed situation is manifest.

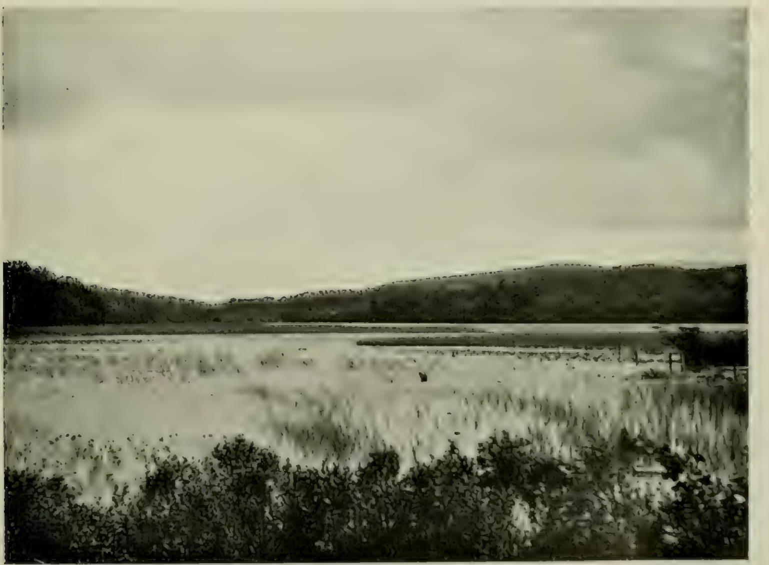

Fig. 58.—Lochaber Loch. View from the north-west, looking south-east, showing Myrica Gale in the foreground, beyond which, in the water, are colonies of Carex rostrata, Phragmites communis, Equisetum limosum, etc. The loch is surrounded by forest to the water's edge, excepting on the north-west.

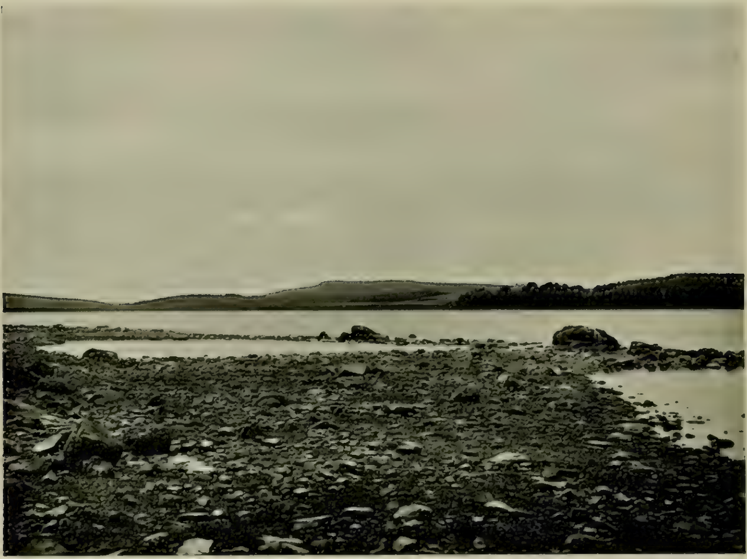

Fig. 59.—Loch Ronald. View from the south-west shore, looking north-east, showing flat stony shore without vegetation, and the plantation of conifers upon the east side of the loch.

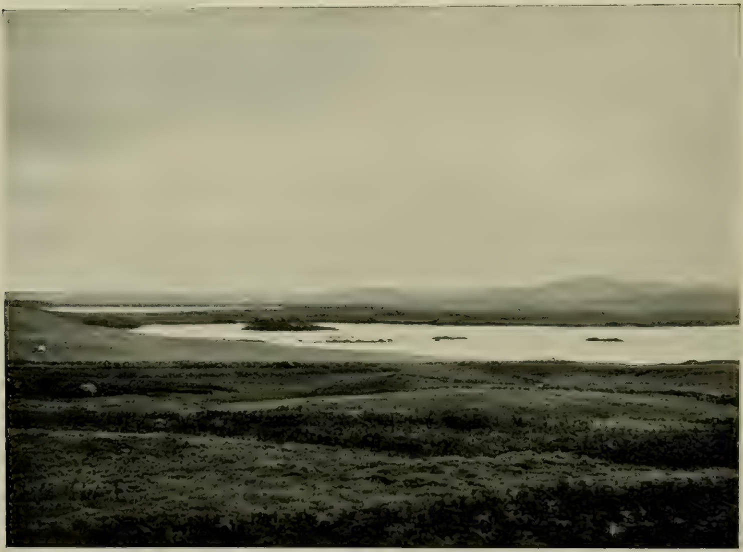

Fig. 60.—Castle Loch, and Mochrum Loch beyond it. View from Challochglass Moor at the north-west of Castle Loch, looking south-east. The island with dwarf trees has upon it the remains of a castle. The other islands are merely bare rocks, and are occupied by cormorants that breed there.

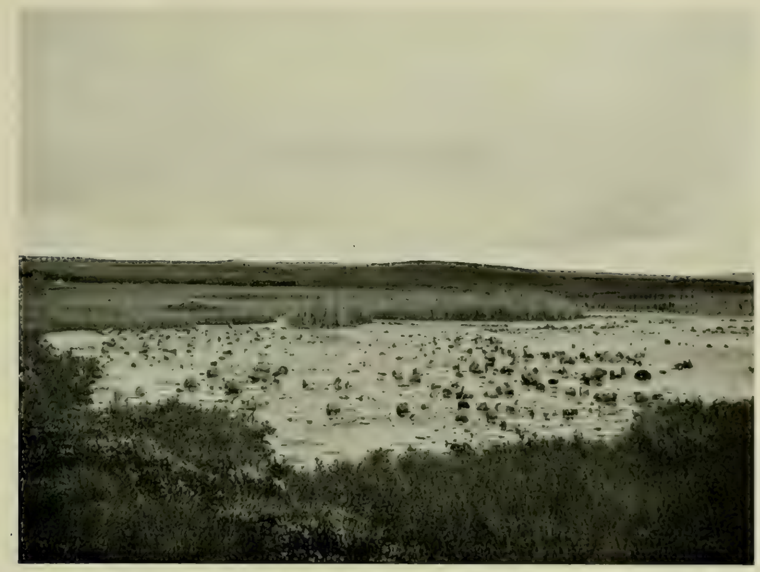

FIG. 61.—A tarn on the moor near Castle Loch, bordered by various plants, such as Phragmites communis, Carex rostrata, Schœnus nigricans, Hypericum elodes, Juncus effusus, Myrica Gale, Calluna vulgaris, etc. Its surface is covered with Castalia speciosa, whose leaves are being raised more than usual by a strong wind.

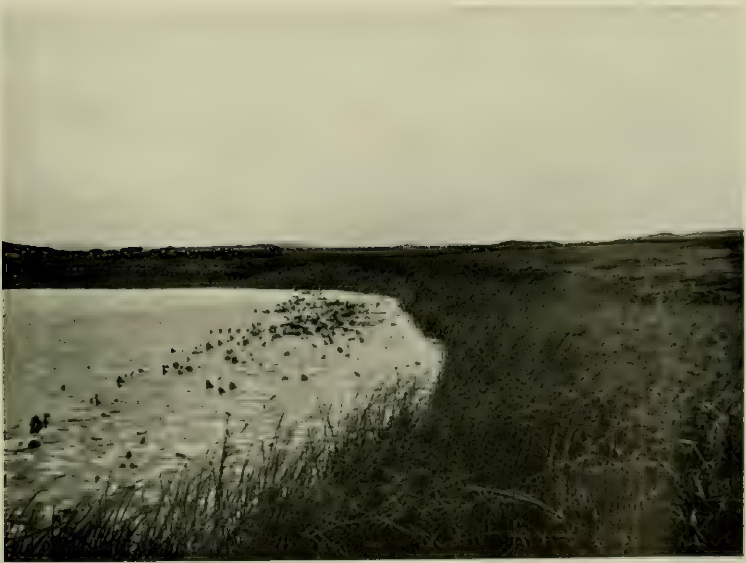

FIG. 62.—A small loch on Anabaglish Moss, with associations of plants in the following order from left to right:—(1) Potamogeton natans; (2) Castalia speciosa; (3) Cladium Mariscus; (4) Schœnus nigricans, Eriophorum polystachion, etc., the last group merging into moorland types.

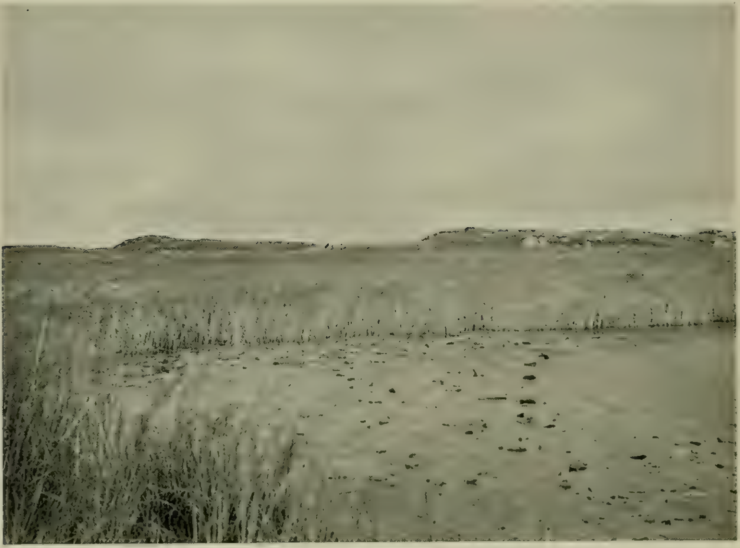

FIG. 63.—White Loch on Anabaglish Moss, showing a portion of the zone of Cladium Mariscus, which entirely surrounds the pool. In the water in front of that species a belt of Castalia speciosa encircles the loch. Behind the Cladium, Carex filiformis, Schœnus nigricans, etc. merge into the types of the moor.

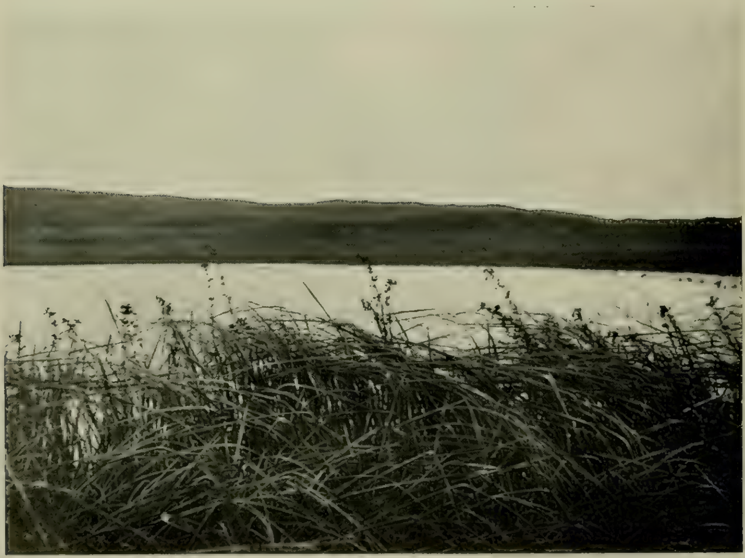

FIG. 64.—Peat Loch on Anabaglish Moss. A near view of a portion of the association of Cladium Mariscus which encircles the loch.

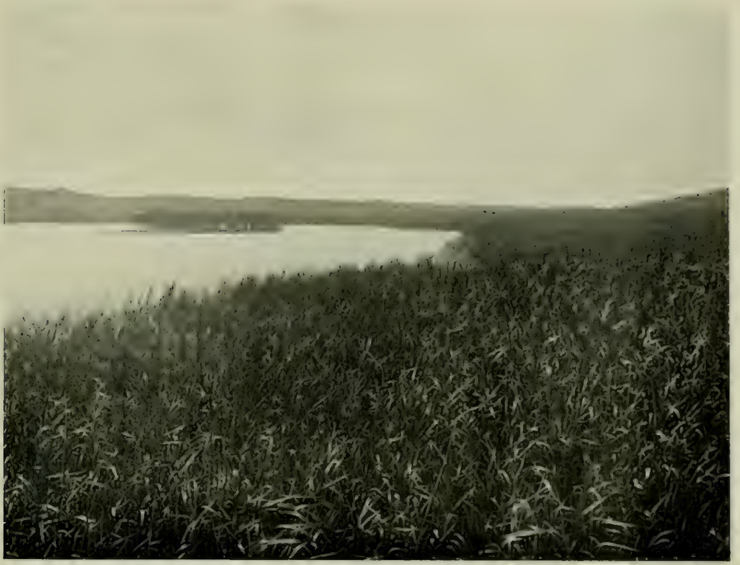

Fig. 65.—Barhapple Loch. View from the north shore, looking south-west, showing the dense association of Phragmites communis which borders the north side; also the island with dwarf trees in the middle of the loch.

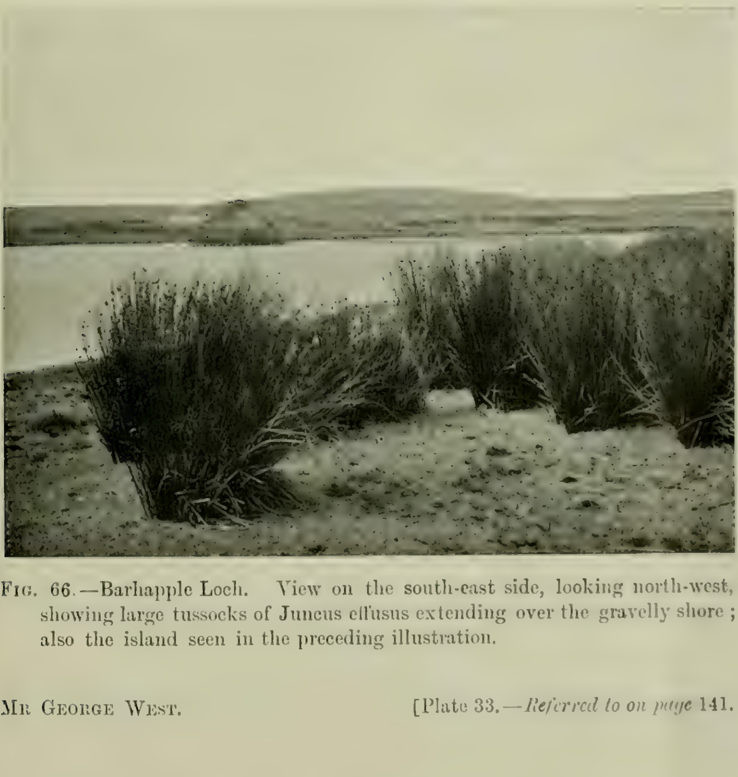

Fig. 66.—Barhapple Loch. View on the south-east side, looking north-west, showing large tussocks of Juncus effusus extending over the gravelly shore; also the island seen in the preceding illustration.

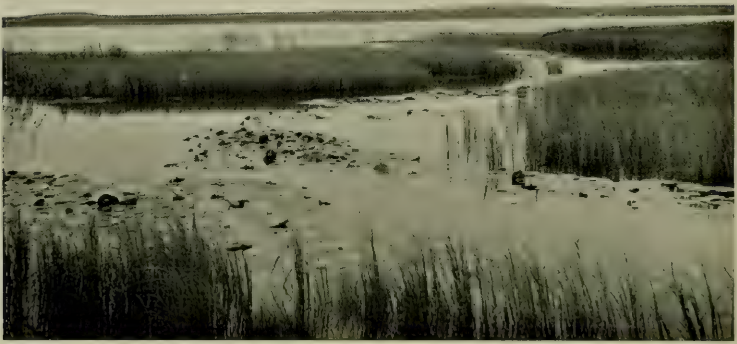

Fig. 67.—Loch Dernaglar. View from the affluent at the south-west, looking north-east, showing Castalia speciosa on the water, dense colonies of Carex rostrata, and behind them a few stems of Phragmites communis, Juncus effusus, etc.

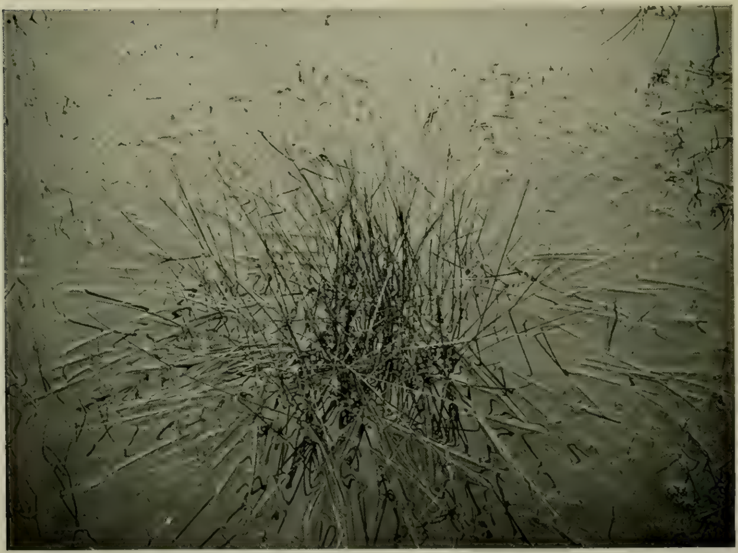

Fig. 68.—Loch Dernaglar. Heleocharis multicaulis, with floating leaves and erect flowering stems; some of the leaves are also erect.

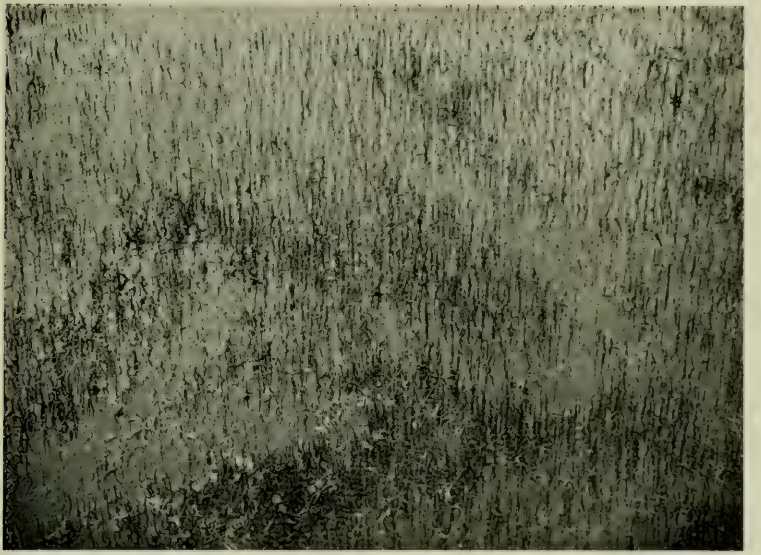

Fig. 69.—Loch Dernaglar. Pilularia globulifera overgrowing a shallow portion of the shore.

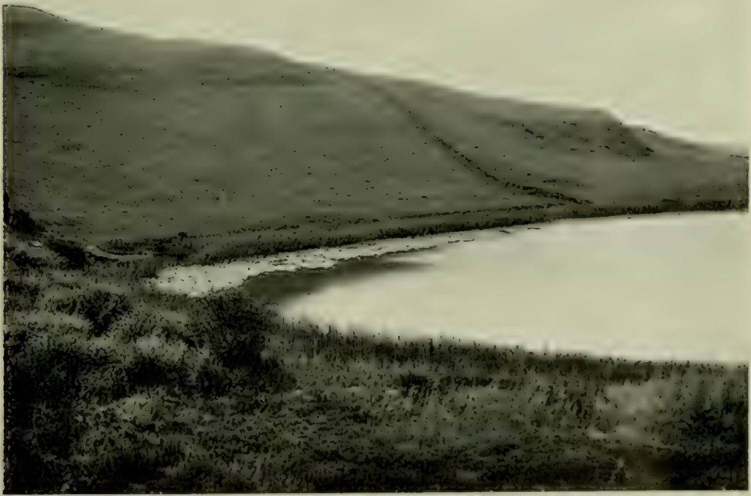

Fig. 70.—Barlockhart Loch. View at the east end, looking south-west, showing the associations of Phragmites, Equisetum, Castalia, etc., as described in the text.

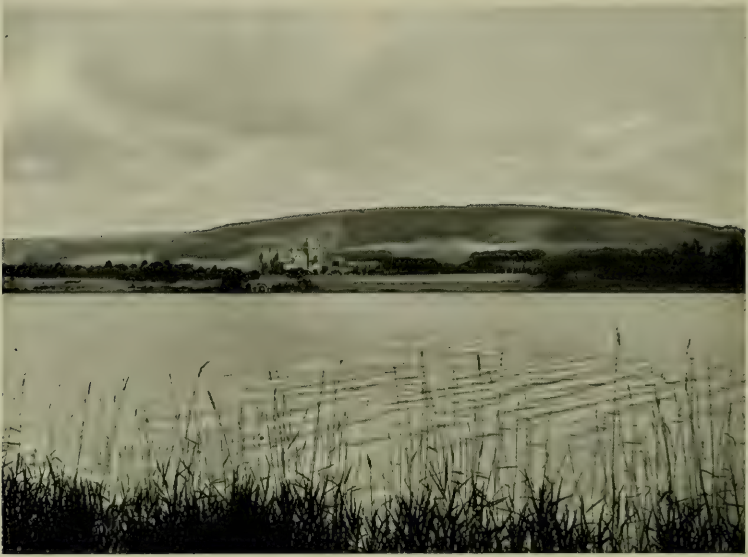

Fig. 71.—White Loch, Castle-Kennedy. View from the large island on the west side, looking north towards Lochinch Castle. Phalaris arundinacea, in the foreground, forms a marginal zone about the island.

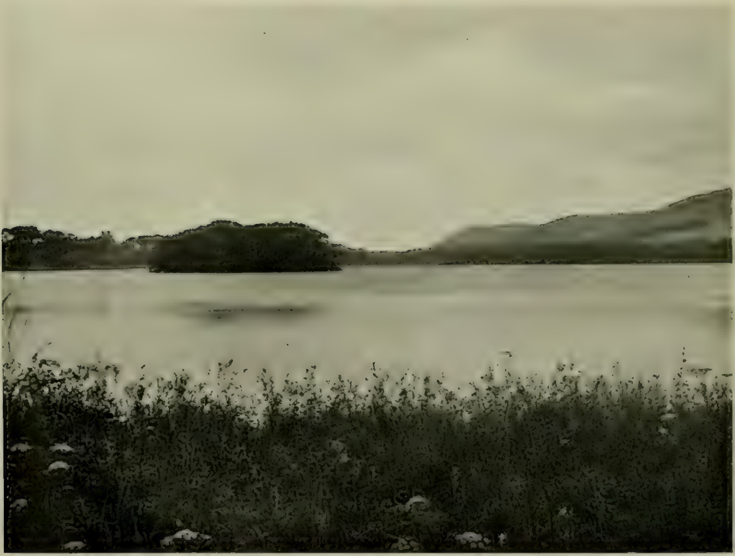

Fig. 72.—Black Loch, Castle-Kennedy. View from the south-east end, looking north-west, showing marsh vegetation in the foreground, island with luxuriant trees, and the wooded east shore of the loch. Lochinch Castle and the terraced grounds appear on the left of the island.

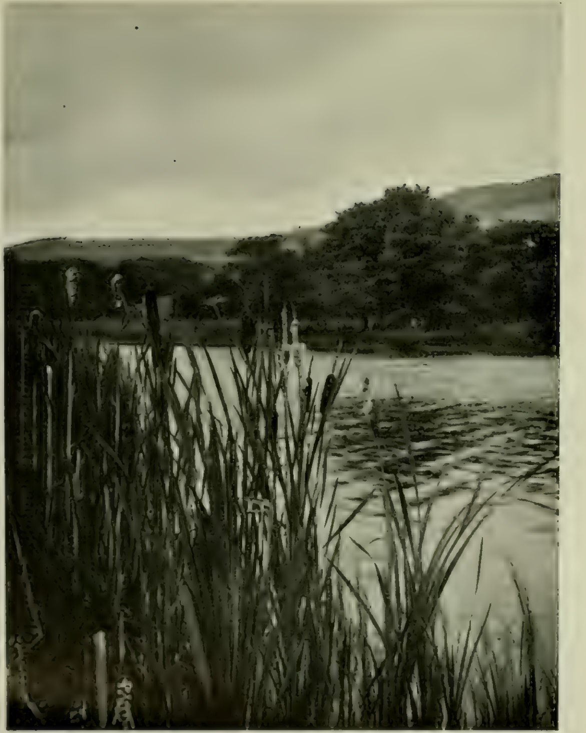

FIG. 73.—Black Loch, Castle-Kennedy. Typha latifolia at the margin of the loch, with its inflorescences; also with those of the previous year (the pale fluffy ones) that have not yet shed the whole of their seed.

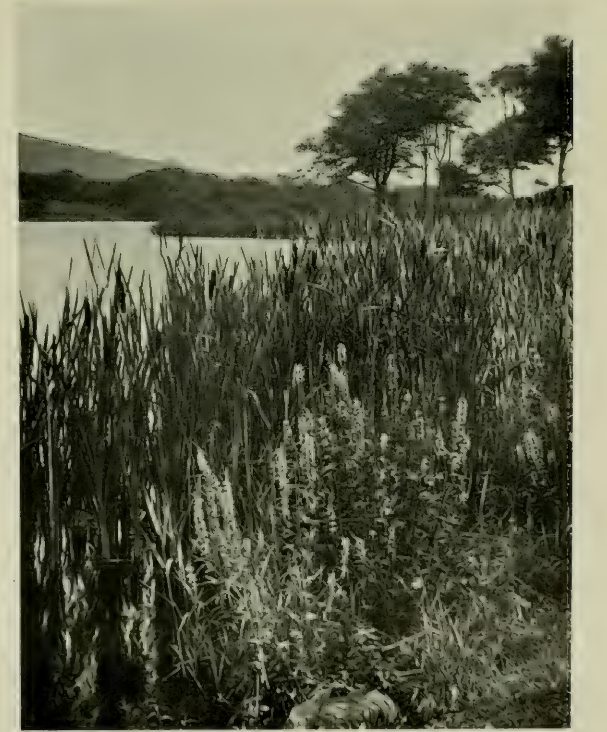

FIG. 74.—Black Loch, Castle-Kennedy. Typha latifolia bordering the loch, behind which Lythrum Salicaria abounds.

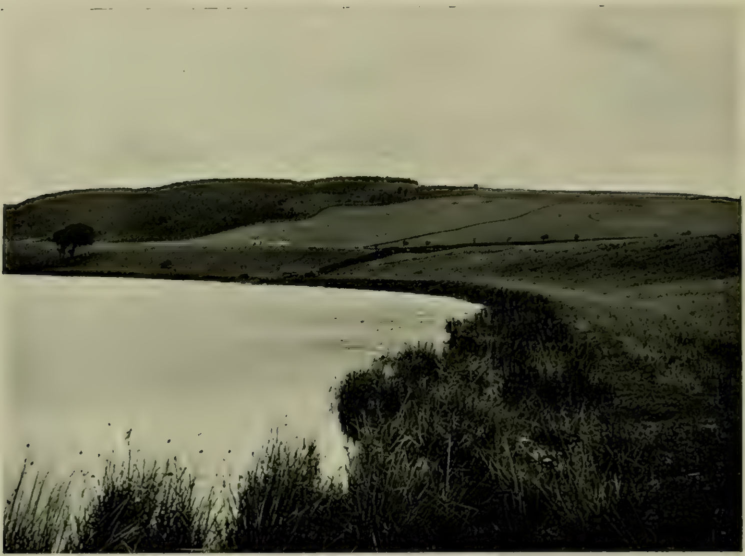

Fig. 75.—Cults Loch. View at the east end of the loch, looking north-west along the shore, showing the narrow zone of marsh, occupied chiefly by Juncus effusus, that intervenes between the water and the meadow. The terrace indicates that the loch has once been of greater extent.

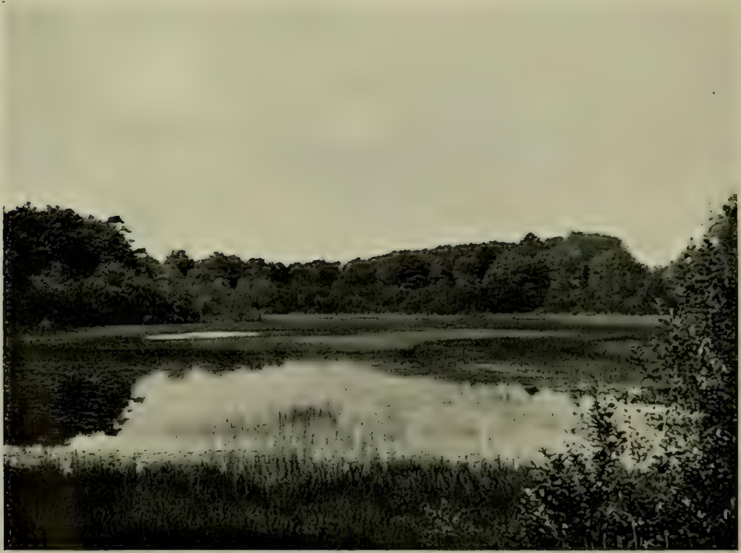

Fig. 76.—A small loch adjoining the railway, a mile west of Castle-Kennedy station. It is almost entirely overgrown by various species of plants common to the district.

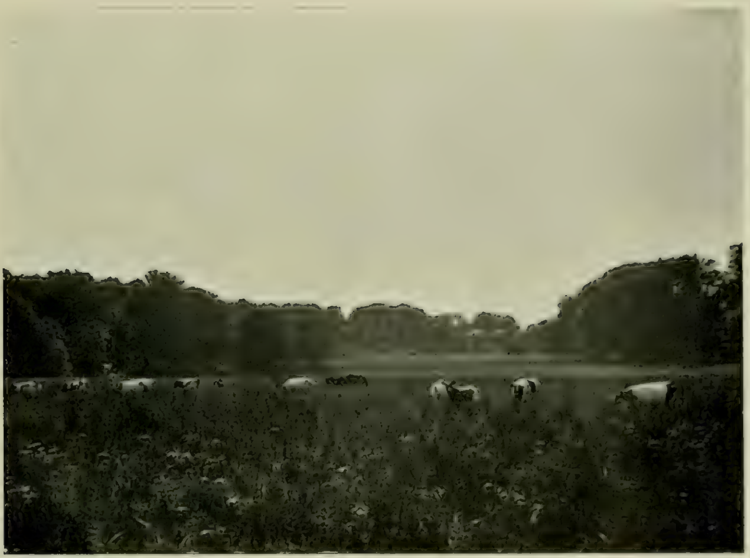

Fig. 77.—Marshy ground of great extent, bordering a small loch near the ruins of Culhorn House. This marsh was probably once a portion of the loch, and the exuberance of the vegetation, which may be judged by the cattle standing amongst it, is reciprocal to the richness of the soil.

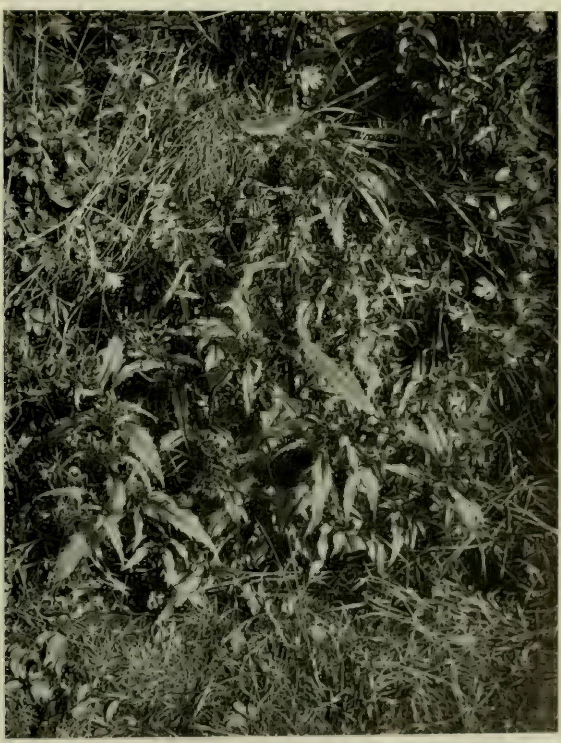

Fig. 78.—Bidens cernua, growing with other herbage in the marsh shown in fig. 77 ; illustrating the luxuriant vegetation of this rich area.

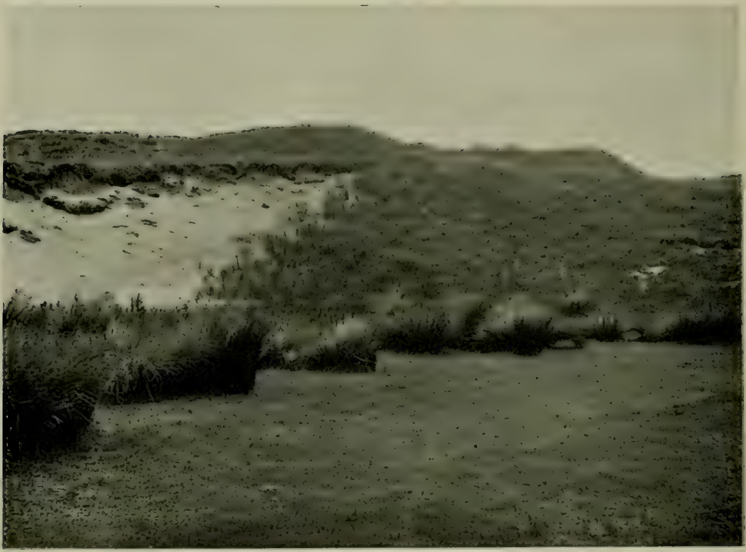

Fig. 79.—Site of a pool on the sands of Luce, dry because of drought. The bottom is now covered with a sward composed of Hydrocotyle vulgaris, Peplis Portula, and Carex arenaria. On the border of the pool great tussocks of Juncus effusus are in close proximity to Ammophila arundinacea, which overgrows the sand hill in the rear.

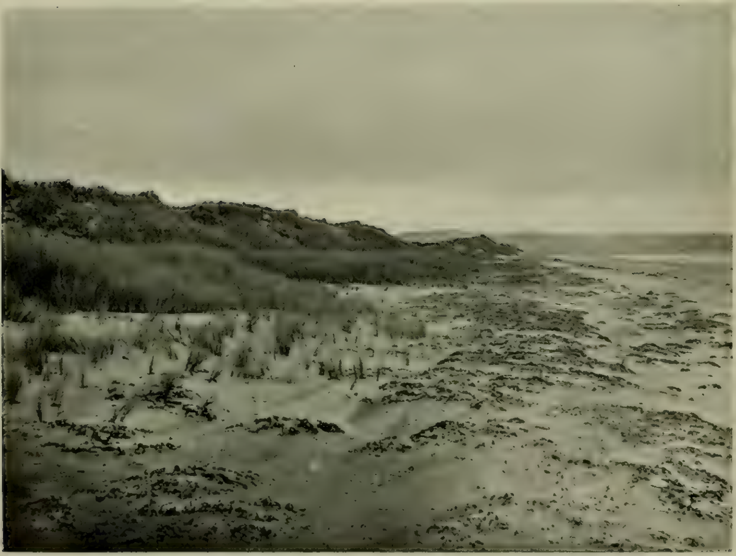

Fig. 80.—View of the sands of Luce bordering the sea, looking along the sandy shore towards Glenluce. The dunes are everywhere capped with Ammophila arundinacea ; and at their base, quantities of dead Algæ are partially engulfed in the sand.

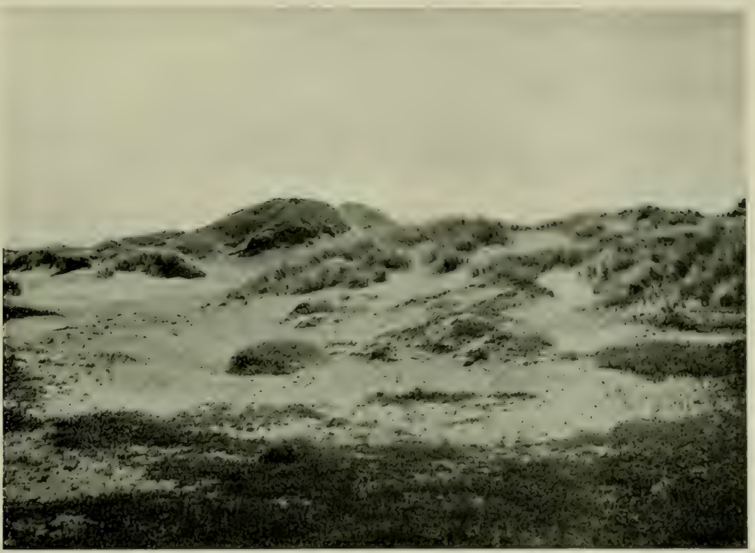

Fig. 81.—Sands of Luce, showing low dunes capped with Ammophila. Upon the lower slopes a kind of sward has been formed, chiefly by Carex arenaria, Salix repens, Hylocomium triquetrum, Rhacomitrium canescens and its var. ericoides.

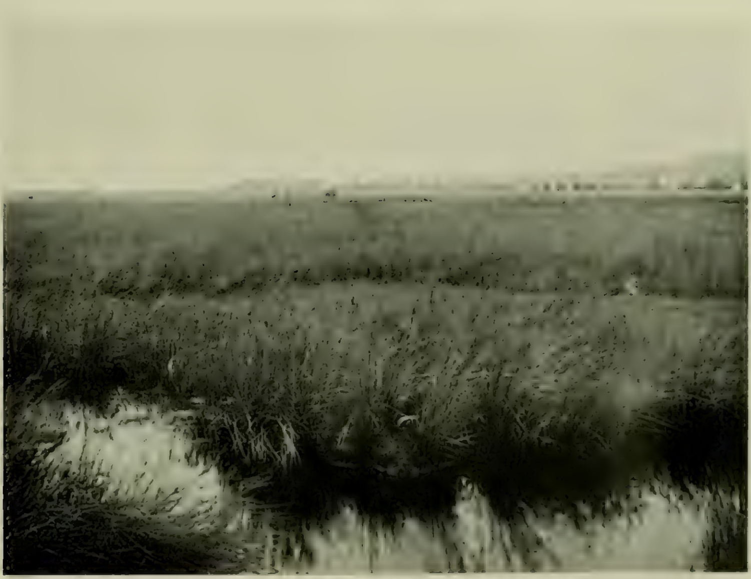

Fig. 82.—Juncus maritimus in a brackish marsh at the east end of the sands of Luce, near Low Torrs.

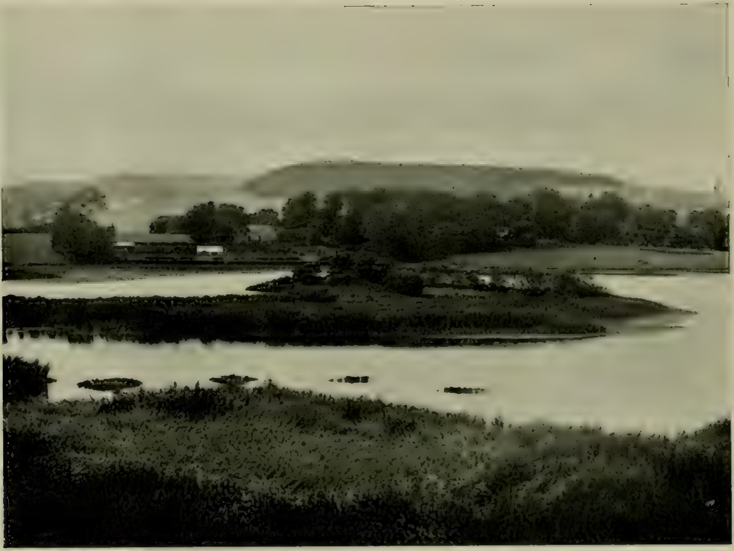

Fig. 83.—Lindores Loch. View from the north-west shore, looking north across the loch. The foreground is covered with an association of Glyceria aquatica, amongst which are groups of Typha angustifolia. In the water there are four pure associations of Menyanthes trifoliata. On the island the vegetation is chiefly composed of Glyceria aquatica, Typha angustifolia, and a few alders. Upon the other side of the loch, to the left, the marshy ground is covered with similar plants.

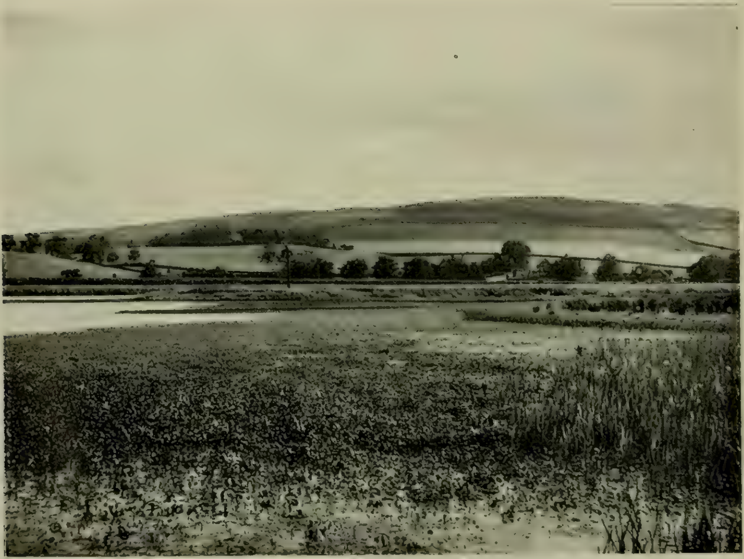

Fig. 84.—Lindores Loch. View from the north-east, looking west along the end of the loch, showing a large association of Polygonum amphibium on the water, which is bordered on the land side by Glyceria aquatica that has been eaten down by cattle. At the other side of the loch a large association of Typha angustifolia extends completely across the picture.

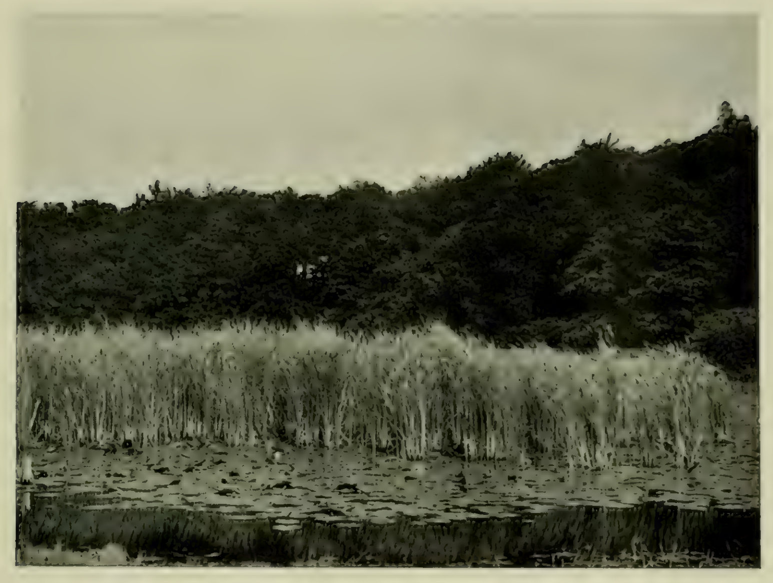

Fig. 85.—Lindores Loch. Typha angustifolia bordering a portion of the east shore, with Nymphæa lutea on the water in front of it, and deciduous trees upon the shore behind.

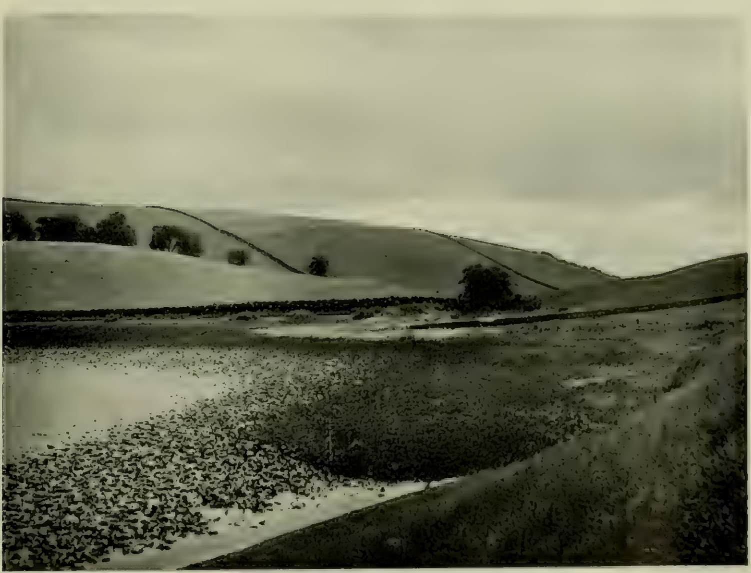

Fig. 86.—Black Loch, North Fife. View from the south shore, looking north-east, meadow-land in the foreground, then a narrow strip of gravelly-muddy shore, close to which is Nymphæa lutea and a broader zone of Castalia speciosa (fig. 87). To the right of the latter there is an association of Menyanthes trifoliata; farther away, and to the right of the Castalia and Nymphæa, there is an association of Equisetum limosum, and behind it Glyceria aquatica. Grain fields cover the distant hills.

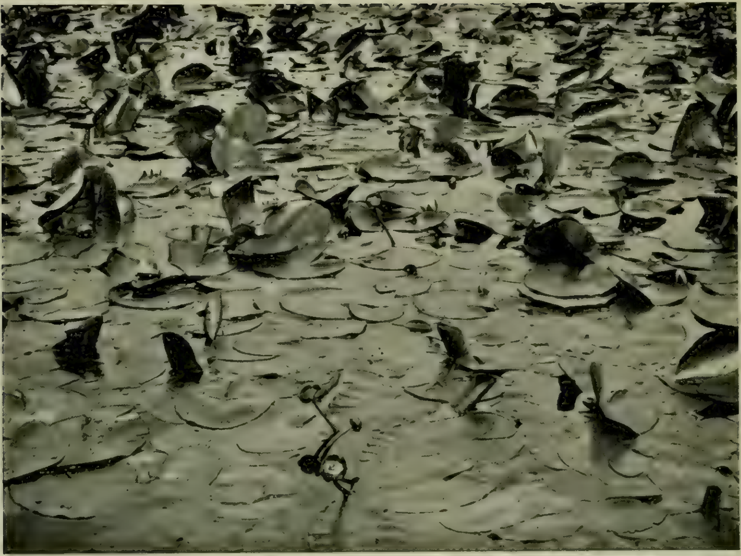

Fig. 87.—Black Loch, North Fife. A portion of the zone of Castalia speciosa and Nymphæa lutea which encircles the loch. The Nymphæa is in the foreground next to the shore, with its leaves flat on the surface of the water, and its flowers raised above the surface. The Castalia is beyond, and has its leaves partially above the surface, and its flowers on the surface of the water (compare figs. 21, 31, and 61).

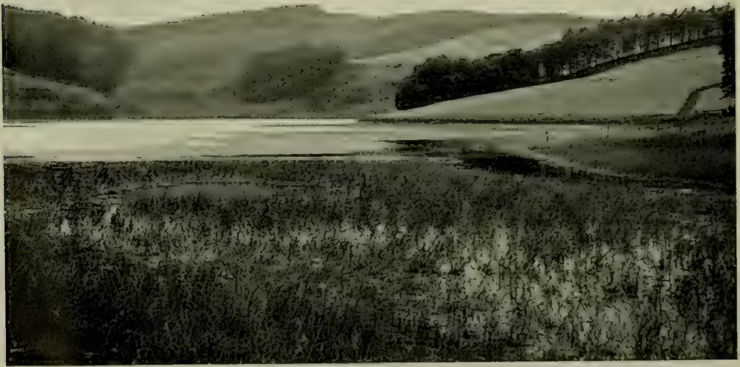

Fig. 88.—Lochmill Loch, North Fife. View from near the effluent at the east end, looking west, showing in the foreground marsh vegetation, which is largely composed of Glyceria fluitans, and beyond this a wide zone of Polygonum amphibium mixed with Potamgeton natans, which extends along the north shore. Hills, with plantations, enclose the loch, excepting at the east end.

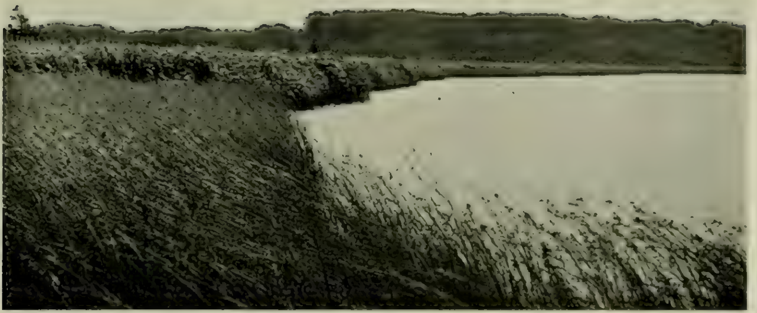

Fig. 89.—Kilconquhar Loch. View of the east shore, showing the dense marginal zone of vegetation, which is composed of an association of Scirpus lacustris in the foreground and Phragmites communis beyond it. The distant trees are in the grounds of Elie House.

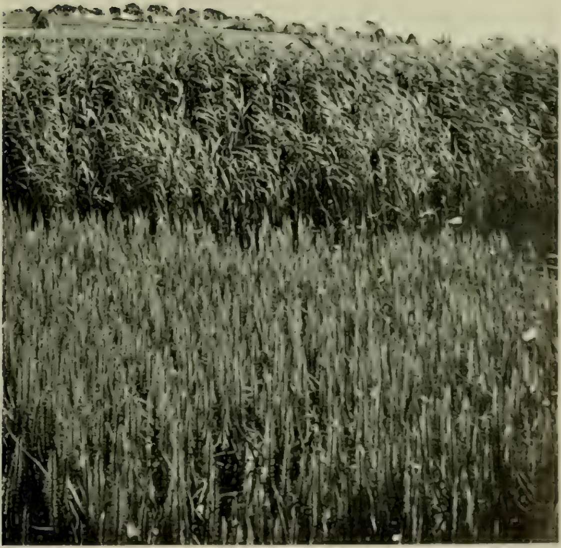

Fig. 90.—Kilconquhar Loch. View on the north side, showing the dense marginal vegetation. Hippuris vulgaris in the foreground, behind which an association of Phragmites communis shuts off the view of the loch. Over the top of the latter species appears the cultivated land to the east of the loch.

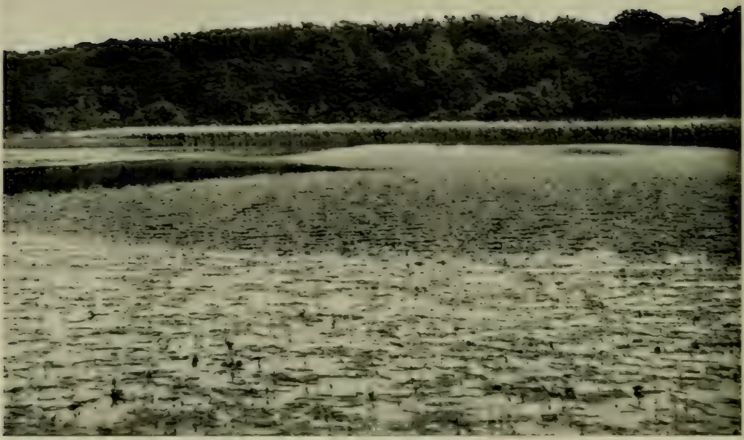

Fig. 91.—Kilconquhar Loch. View from a boat at the south-east corner of the loch, looking towards Elie House, showing a portion of the large association of Polygonun amphibium, with its floating leaves and flowers above the surface of the water.

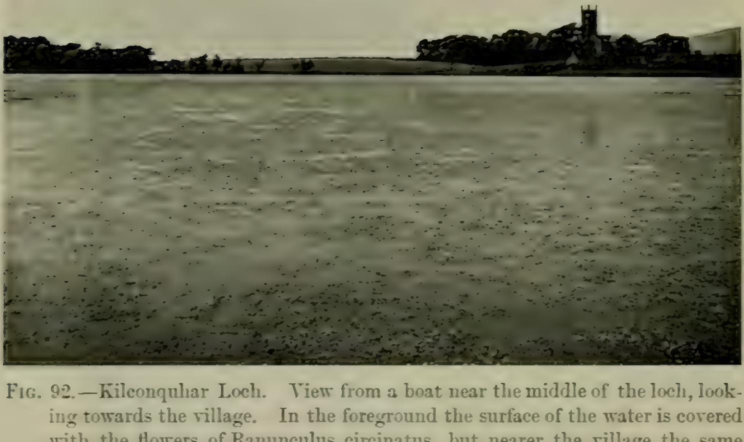

Fig. 92.—Kilconquhar Loch. View from a boat near the middle of the loch, looking towards the village. In the foreground the surface of the water is covered with the flowers of Ranunculus circinatus, but nearer the village the same species is mixed with R. Baudotii.

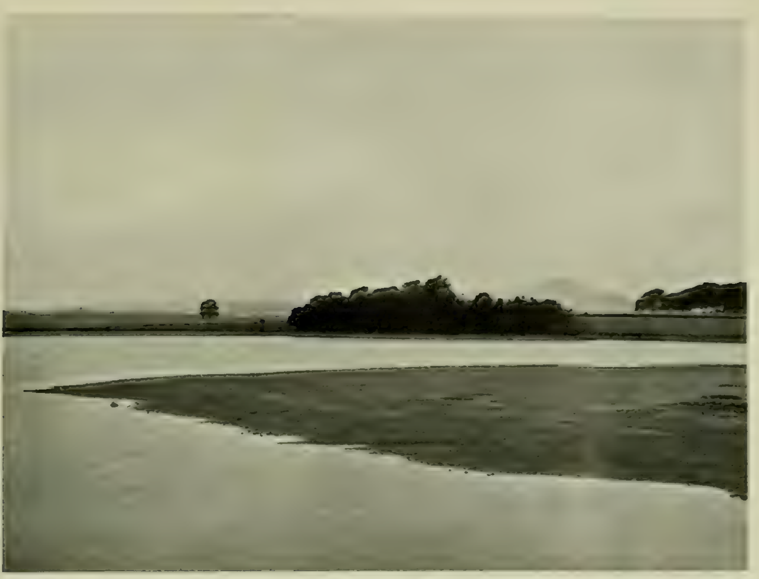

FIG. 93.—Carriston Reservoir. View from the island at the east side, looking west towards the Lomond Hills, of which the East Lomond appears on the right. The extensive sandy shore in the foreground has been exposed through the falling of the water level, and a few aquatic plants which grew there are now dead.

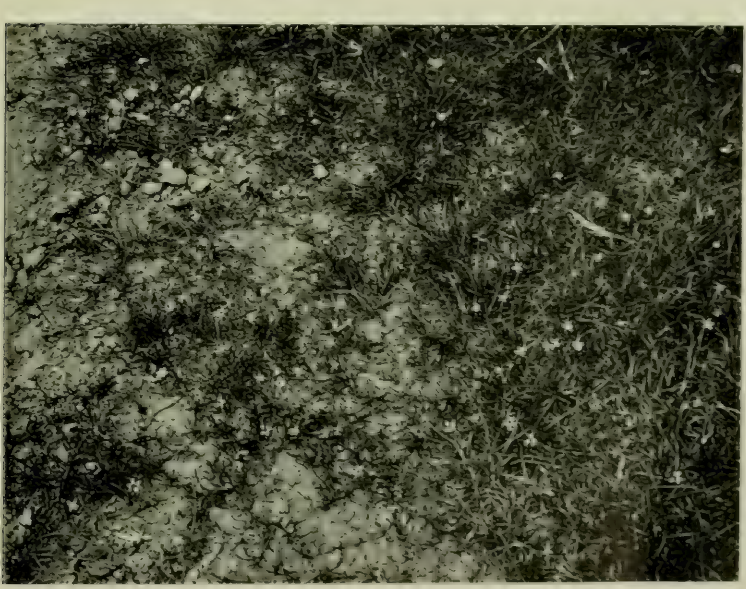

FIG. 94.—Carriston Reservoir. Ranunculus reptans, on the sandy shore at the north side.

MR GEORGE WEST.

[Plate 47.—*Referred to on page* 156.

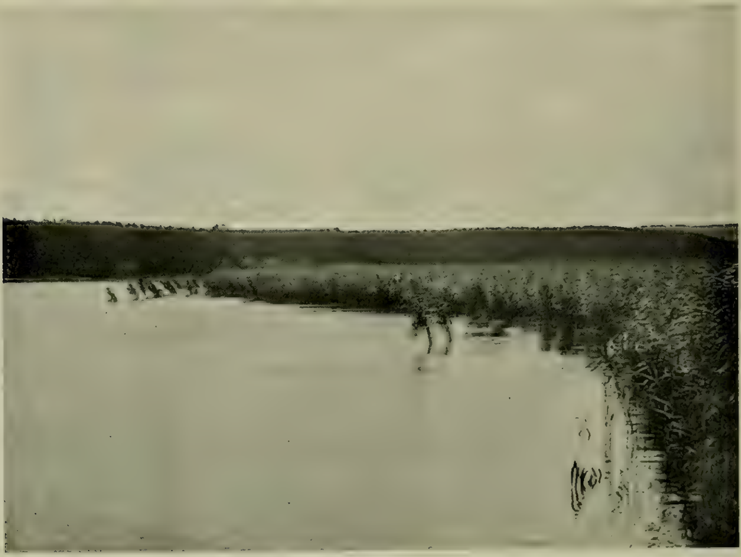

Fig. 95.—Loch Gelly. View of the west shore, looking south along the margin of the large association of Phragmites communis, showing here and there isolated groups that extend into the loch beyond the main body. In the distance is seen the coniferous wood that extends along the south shore.

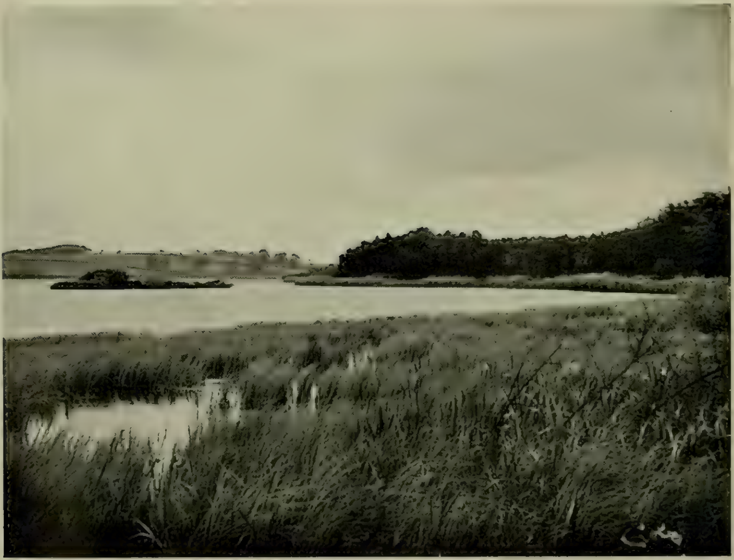

Fig. 96.—Loch Gelly. View of the south shore looking east, showing the zone of marsh that extends along this side of the loch, and behind it a strip of coniferous wood. Carex rostrata occupies the foreground, and the small island is overgrown with Spiræa, Carex, etc.

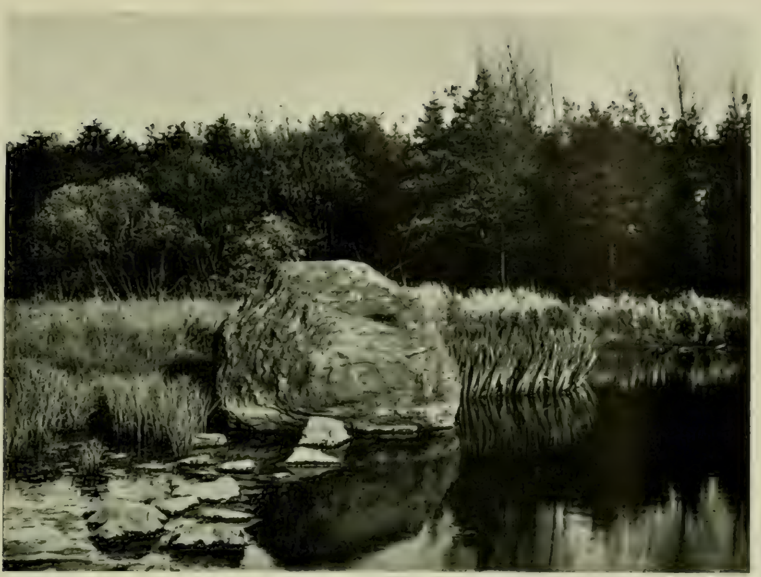

Fig. 97.—Loch Gelly. View of a portion of the south shore from the water In the centre is shown a large schistose rock of glacial origin, and the only feature of this kind about the loch. On the left Carex rostrata, on the right Iris Pseud-acorus, and the plantation in the rear as seen in figs. 95 and 96.

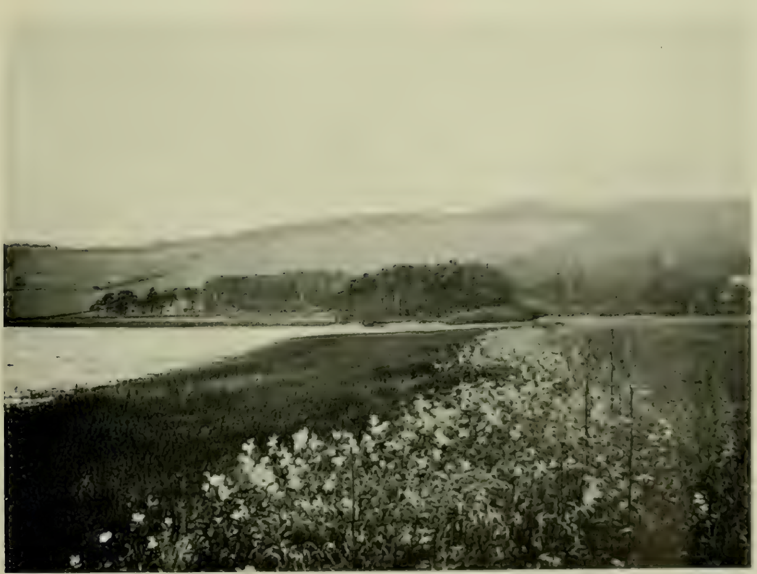

Fig. 98.—Burntisland Reservoir. View along the north-east shore, looking west towards Cullalo Hill. Near the water the shore is covered with Littorella lacustris, then there is a broad zone of Heleocharis palustris, followed by a narrow strip of Spiræa Ulmaria, which is succeeded by meadow-land.

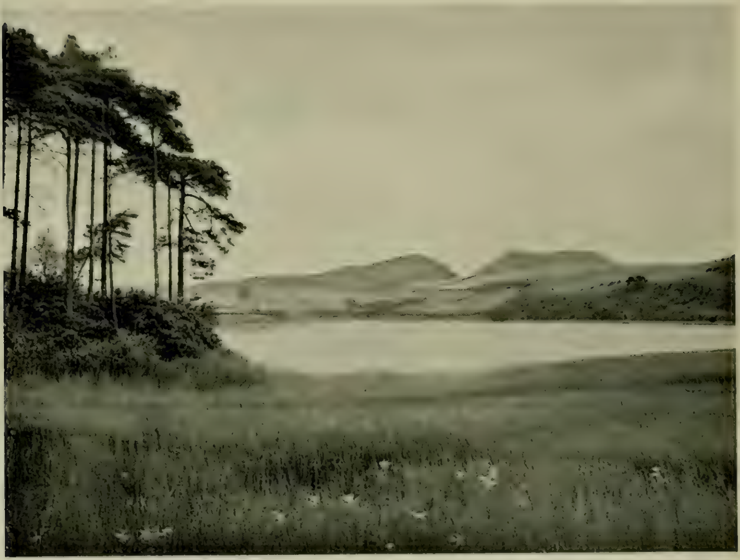

Fig. 99.—Burntisland Reservoir. View from the north-west side, looking east towards Dunearn Hill. In the foreground are Spiræa Ulmaria, Juncus acutiflorus, and Heleocharis palustris; Pinus sylvestris and Ulex europæus occupy the mound on the left.

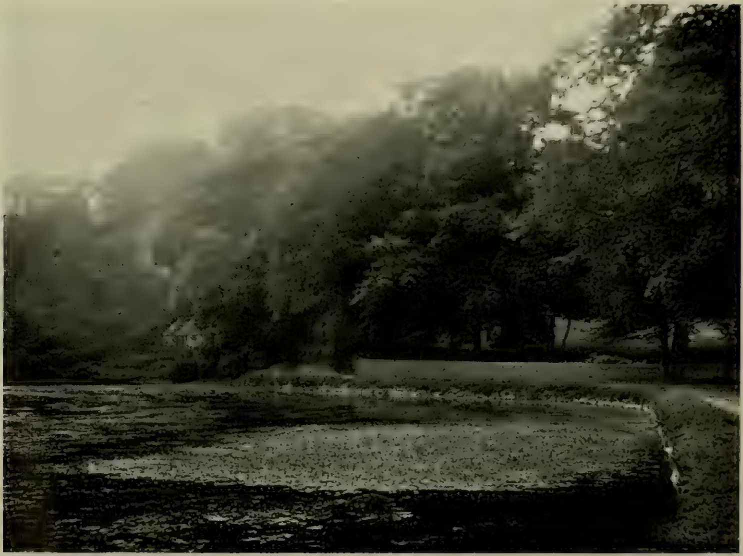

Fig. 100.—Otterston Loch. View along the north shore, looking west, showing the public road, which is separated from the loch by a grassy bank that dips into the water, the luxuriance of the surrounding trees, and the surface of the water covered with Polygonum amphibium.

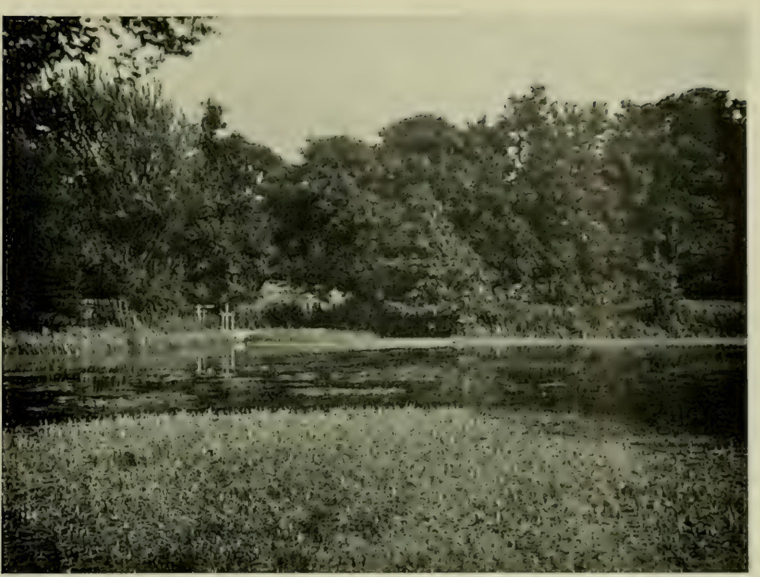

Fig. 101.—Otterston Loch. View from a similar position to that of fig. 100, but looking in the opposite direction, showing a portion of a large association of Polygonum amphibium on the water in the foreground, and the bank below the trees covered with marsh plants, such as Carex rostrata, C. paniculata, Phalaris arundinacea, etc.

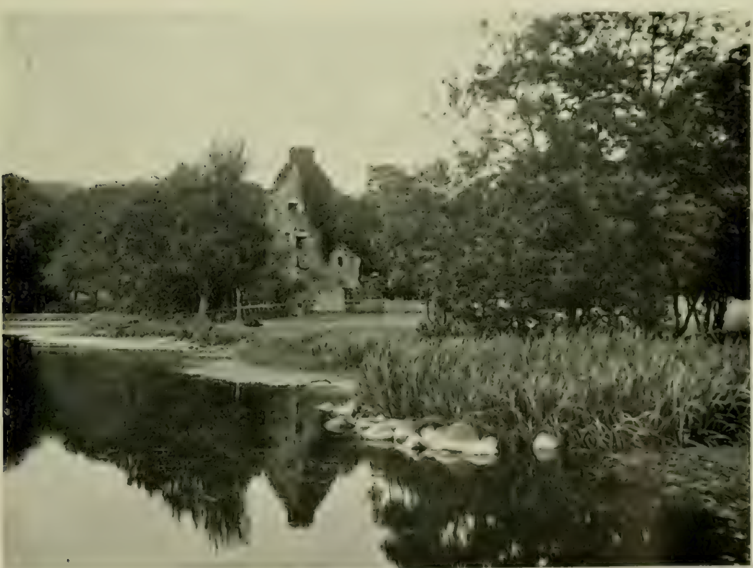

Fig. 102.—Otterston Loch. View along the east shore, looking north, showing Iris Pseud-acorus, etc. at the margin, which is stony in some places. The ruin in the centre of the picture is of historical interest.

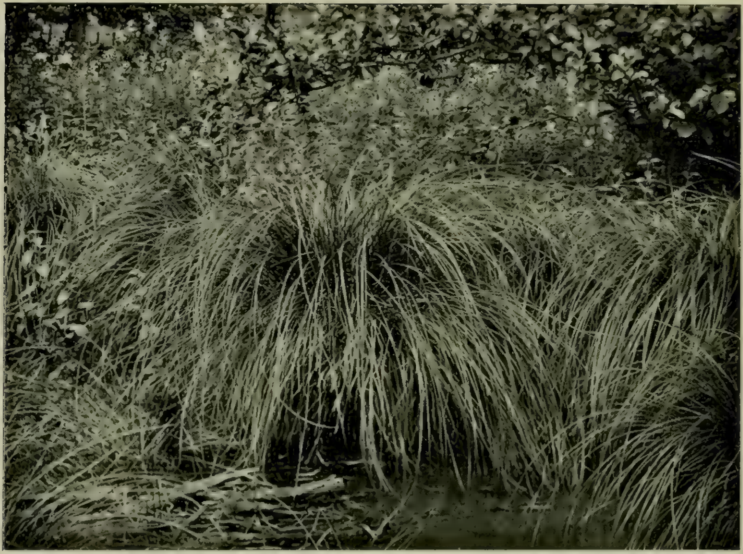

Fig. 103.—Otterston Loch. Tussocks of Carex paniculata growing in the deep bog at the west end of the loch, where they extend over a large area.

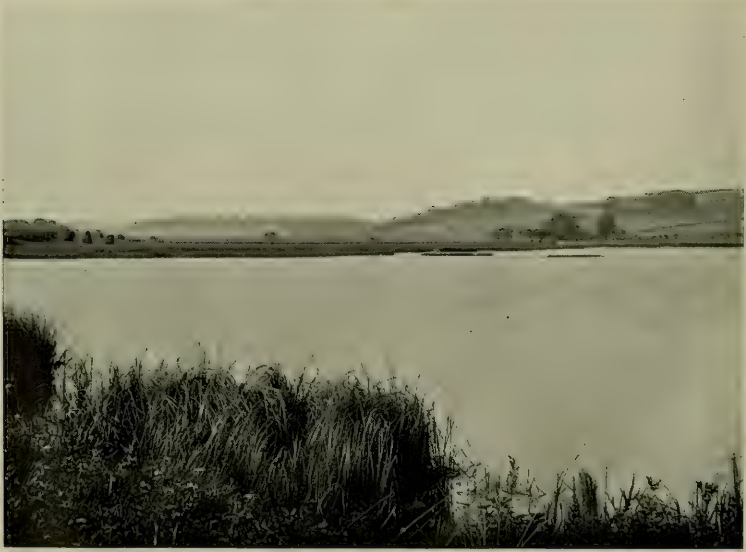

Fig. 104.—Loch Fitty. View from the south shore, looking towards the extensive marsh at the west end, which is seen in the distance. The plant in the foreground next the water is Carex aquatilis.

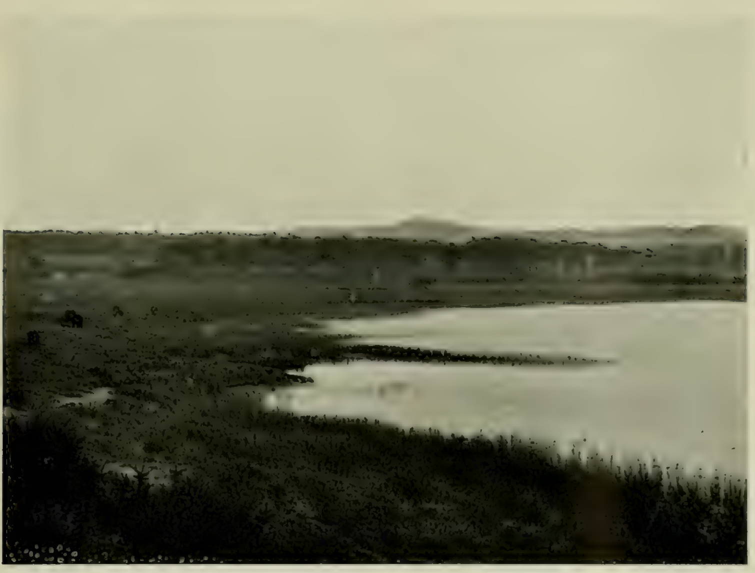

Fig. 105.—Loch Fitty. View of the marshy area at the east end of the loch, from the north shore.

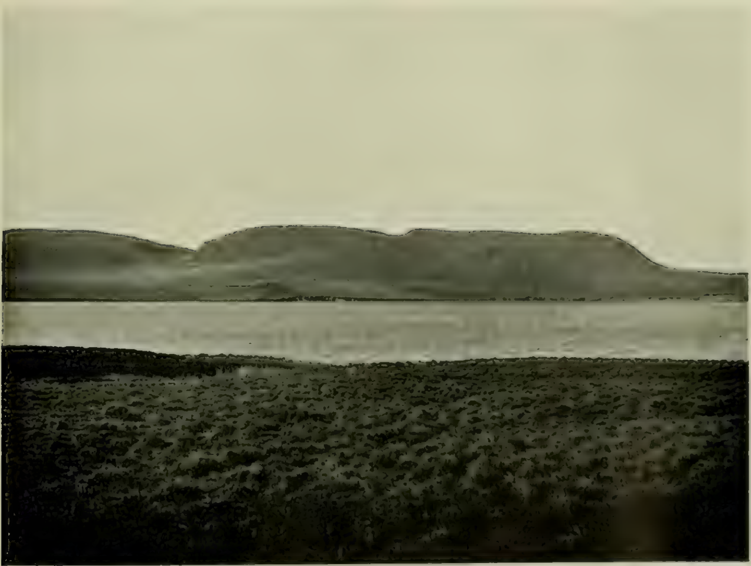

Fig. 106.—Loch Glow. View from the south shore, looking north. The foreground is covered with grass and grass-like moor plants, below which there is deep peat, and the shore at this side is peaty. At the opposite side a thin layer of peat has been washed away, exposing either glacial gravel or volcanic rock, and the shore there is formed of these materials. The margin of this loch is almost devoid of either marsh or aquatic vegetation.

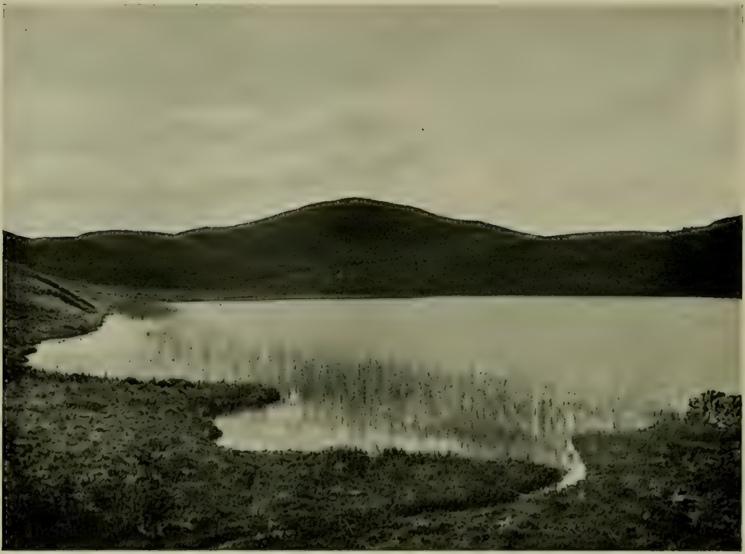

Fig. 107.—Black Loch, Cleish Hills. View from the east end, looking west, showing Phragmites communis skirting the south shore, and the grassy moor extending to the margin of the water. The effluent, which flows into Loch Glow, is seen in the foreground.

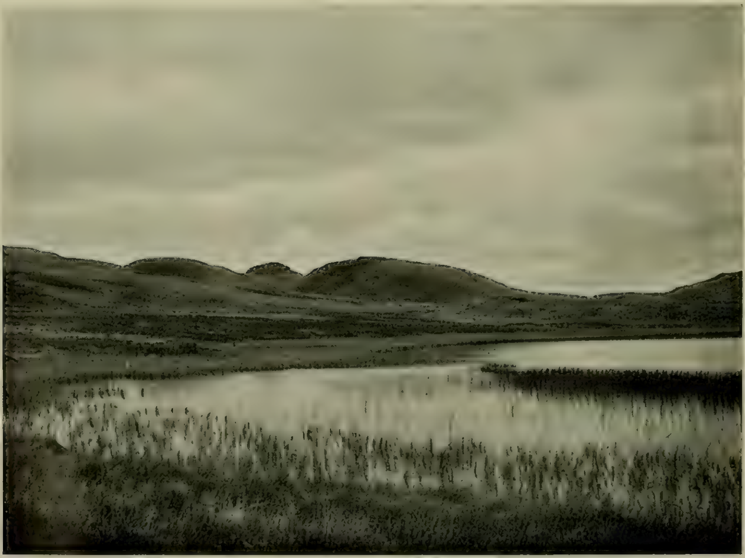

Fig. 108.—Loch Dow, Cleish Hills. View of the west side from the south end, looking north-west, showing Carex rostrata bordering the west side of the loch. The darker patch standing out of the water on the right is an association of Equisetum limosum.

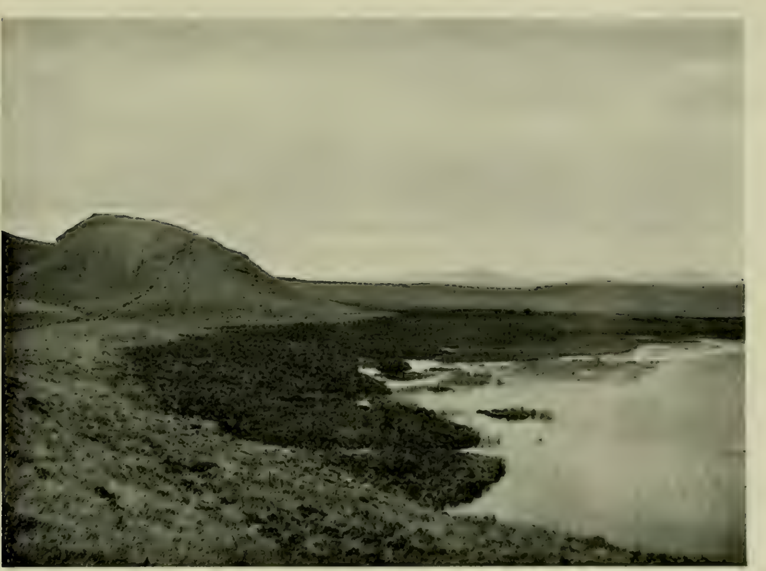

FIG. 109.—Loch Larg, Cleish Hills. View from the south-east, looking north-west, showing the boggy area on the west side as described in the text. The Ochil Hills appear in the distance.

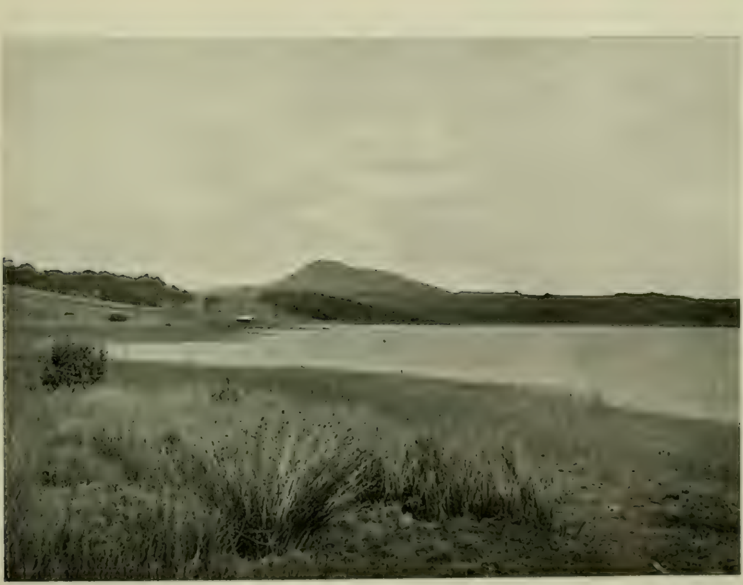

FIG 110.—Harperleas Reservoir. View from the north-west end, looking east along the north shore, with East Lomond Hill in the distance. Juncus effusus and Carex rostrata occur in the foreground. Nearer the water, a zone of Equisetum limosum, which extends along this side of the loch, has more or less died down owing to the receding of the water.

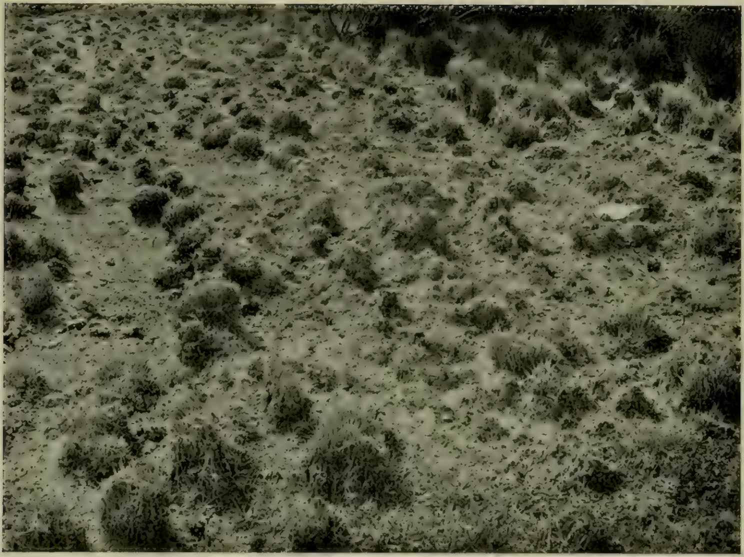

FIG. 111.—Harperleas Reservoir. View on the north-west shore, showing tussocks of Molinia cærulea that have been drowned. Those in the foreground, which is next the water, are quite dead, having suffered a longer submersion than those in the background, which are still living, whilst the intermediate tussocks exhibit a little vitality.

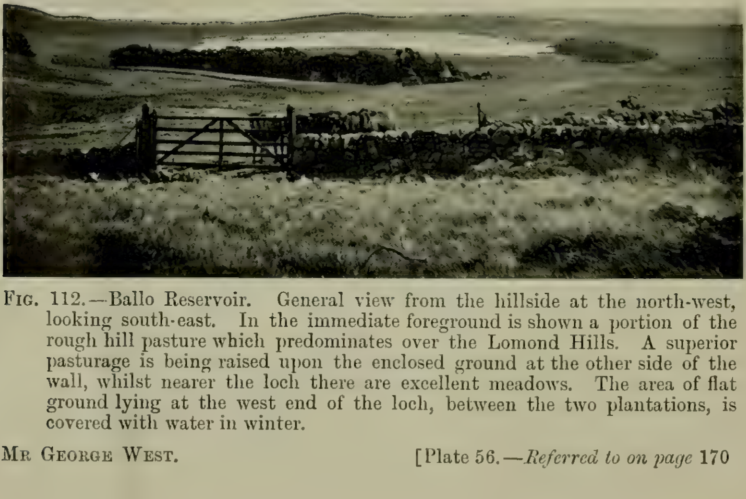

FIG. 112.—Ballo Reservoir. General view from the hillside at the north-west, looking south-east. In the immediate foreground is shown a portion of the rough hill pasture which predominates over the Lomond Hills. A superior pasturage is being raised upon the enclosed ground at the other side of the wall, whilst nearer the loch there are excellent meadows. The area of flat ground lying at the west end of the loch, between the two plantations, is covered with water in winter.

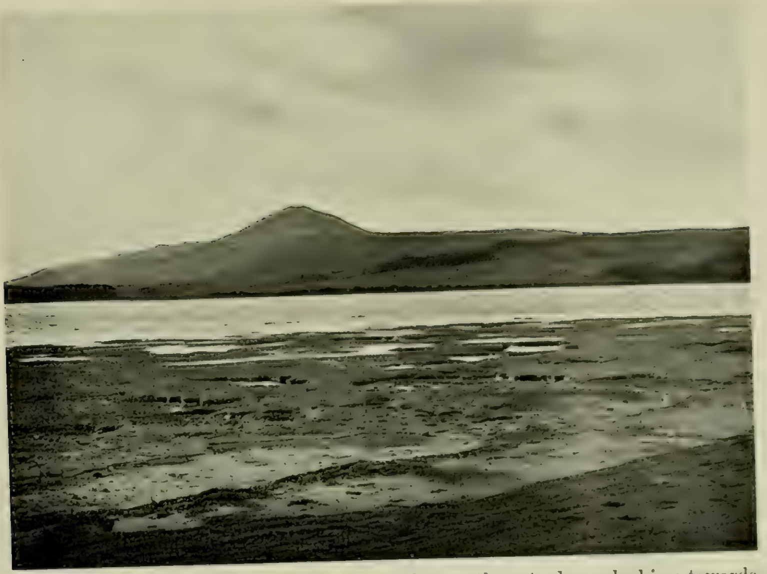

FIG. 113.—Ballo Reservoir. View from the south-east shore, looking towards West Lomond Hill. The flat peaty shore, with pools here and there, has been exposed through drought, and is now more or less covered with Juncus supinus, var. fluitans, growing as a terrestrial plant, and reverting towards the type.

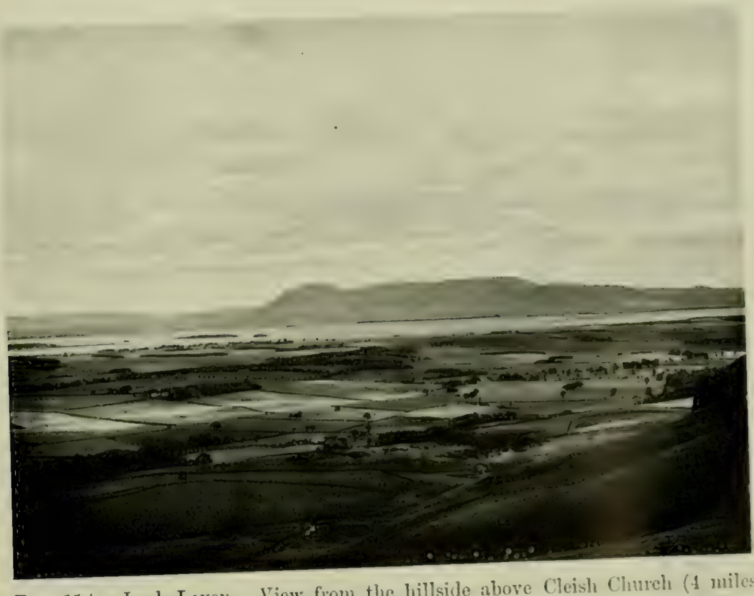

FIG. 114.—Loch Leven. View from the hillside above Cleish Church (4 miles from the loch). The Lomond Hills appear in the distance; the top of East Lomond Hill is seen just above St Serf's Island on the right of the picture. Most of the other islands are also shown. The low-lying land in the middle distance, forming the Plain of Kinross, is intensely cultivated.

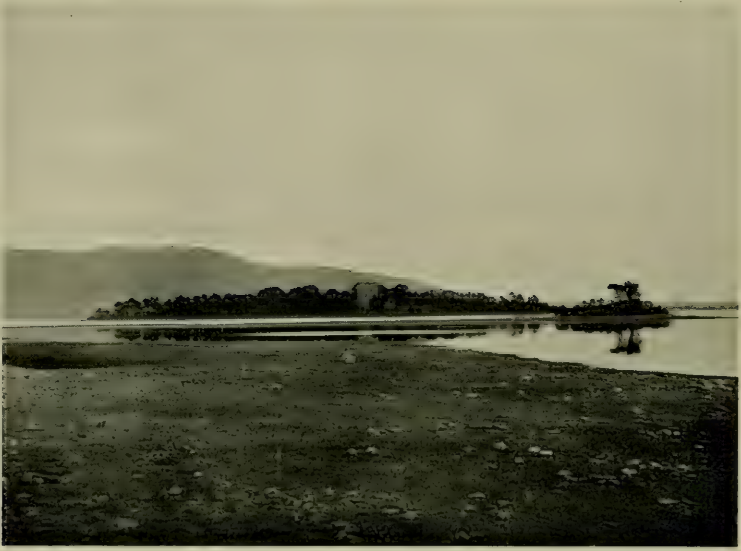

Fig. 115.—Loch Leven. View from the west shore, looking east, showing the great extent of barren, flat, sandy-stony shore, and the islands Roy's Folly and Castle Island. Behind the latter, White Craigs Hill appears in the distance.

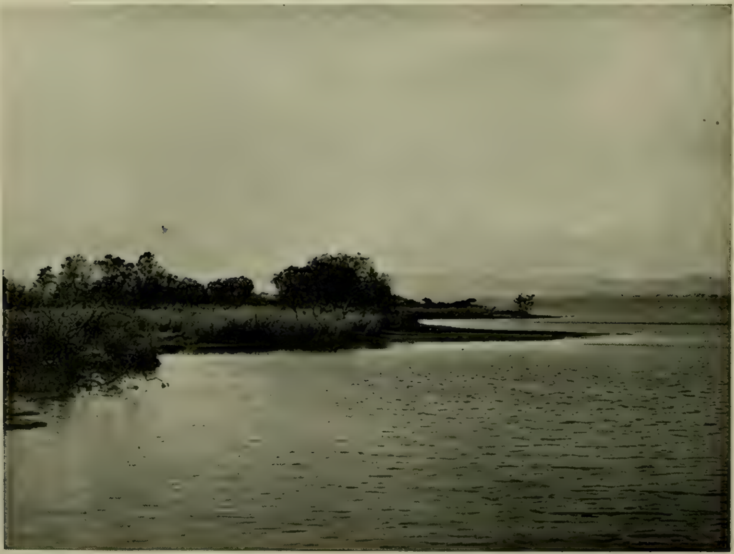

Fig. 116.—Loch Leven.—View on the south shore opposite St Serf's Island, looking towards Kinross, showing the marshy shore. The undergrowth is chiefly Juncus effusus and Carex rostrata. The bushes are Salix aurita, Alnus glutinosa, and Betula glutinosa.

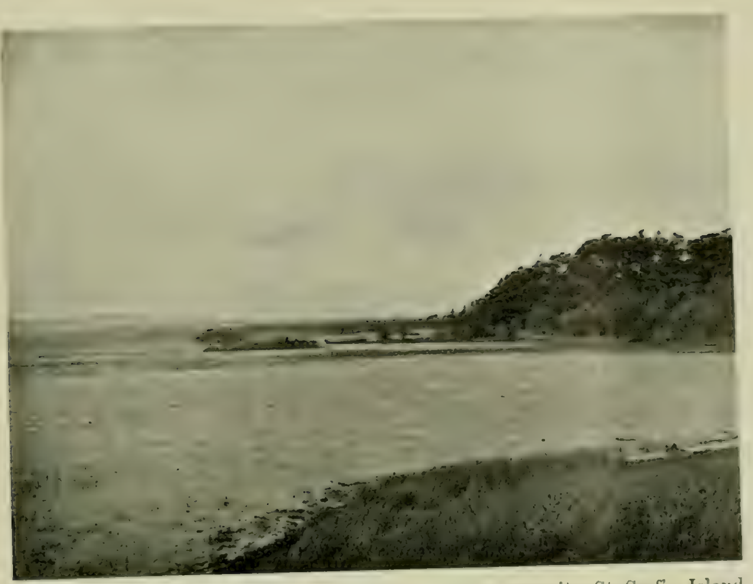

Fig 117.—Loch Leven. View of the east shore opposite St Serf's Island, looking north-west. The scattered marsh plants are chiefly Equisetum limosum, Heleocharis palustris, and Carex rostrata. Dry parts of the shore, as in the foreground, are clothed with grasses. Then follows a strip of Alnus and Salix, behind which there is a plantation of Pinus sylvestris.

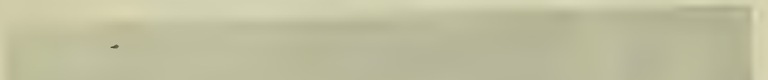

Fig. 118.—Isle of May. View from the north-east end of the island, looking south-east along the eastern shore, showing the gradual inclination of the land from the sea. The whole of this area is swept by sea-spray during every stiff easterly breeze, and the vegetation consists chiefly of the lichens enumerated under fig. 120.

Mr George West.

[Plate 59.—*Referred to on pages* 171 *to* 173.

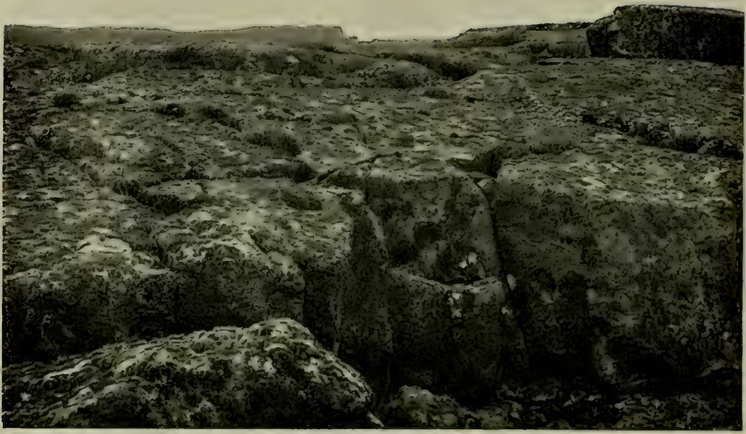

Fig. 119.—Isle of May. View from near the same place as fig. 118, but looking in a westerly direction towards the higher portion of the island. The zone of rock that produces nothing but lichens lies between this spot and high-water mark. In the foreground of the present view is seen the vanguard of the phanerogamic vegetation, dwarf tussocks of Armeria maritima having obtained a hold in the interstices of the lichen-covered rocks.

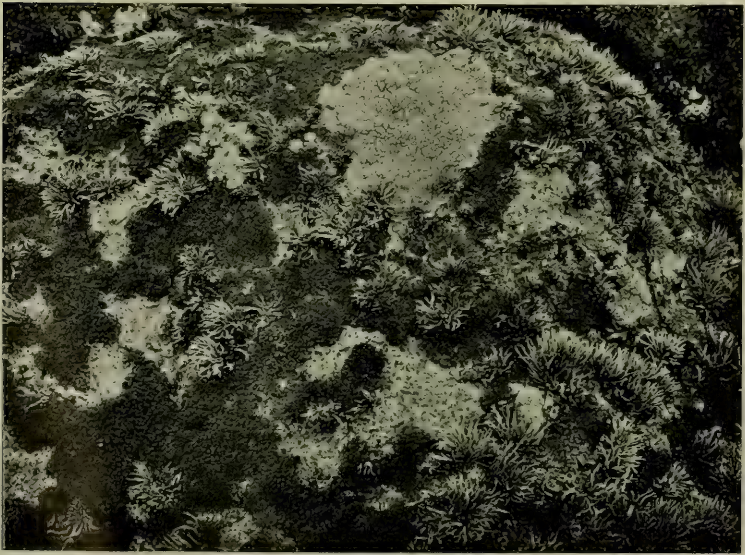

Fig. 120.—Isle of May. Nearer view of the lichens mentioned under fig. 118. They are as follows:—Lecanora parella, Physcia parietina, P. aquila, and Ramalina scopulorum.

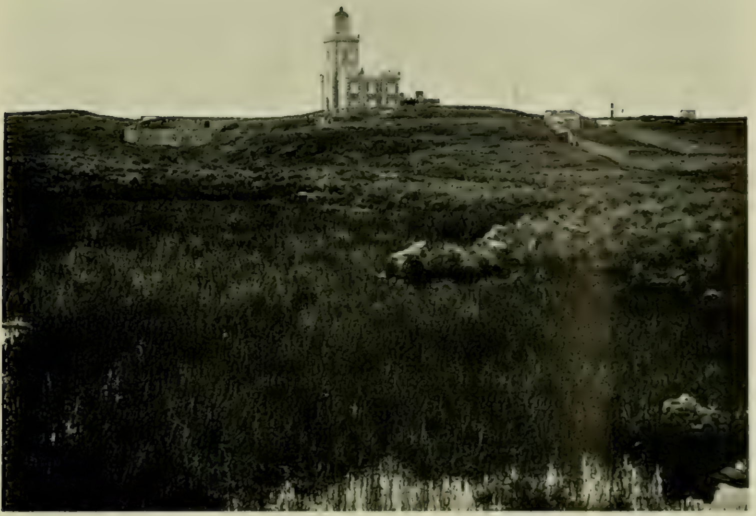

FIG. 121.—Isle of May. One of the pools on an exposed part of the island near the lighthouse. A dwarf form of Heleocharis palustris, with which H. uniglumis is mixed, overgrows the entire area of the pool.

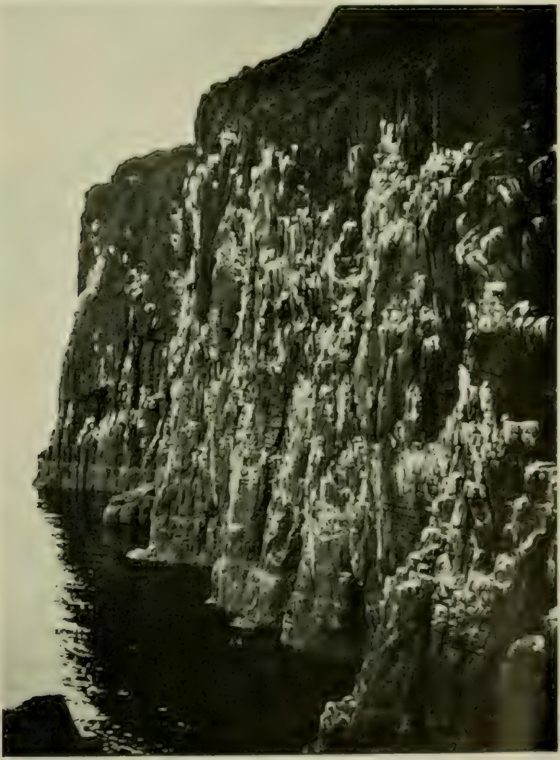

FIG. 122.—Isle of May. Precipitous cliff on the west of the island, consisting of black columnar basalt. The cliff is inhabited by great numbers of sea-birds, whose nests are placed chiefly upon the exposed ends of the columns, the black rock being whitened by the droppings from the birds. It is nearly low water, and the light zone at the base of the cliff is caused by the abundance of Balanidæ, etc.

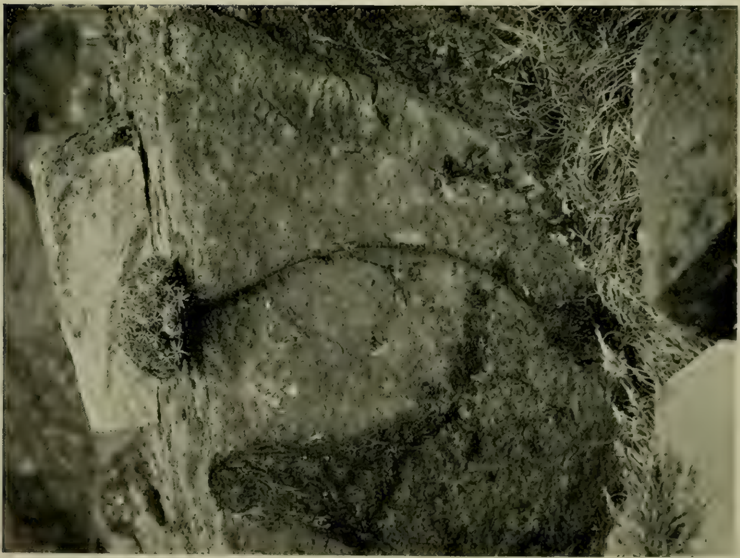

Fig. 123.—Isle of May. A cushion-like tussock of Armeria maritima. The front of the rock on which it is growing was removed in order to exhibit the great length of root which had penetrated a fissure of the rock.

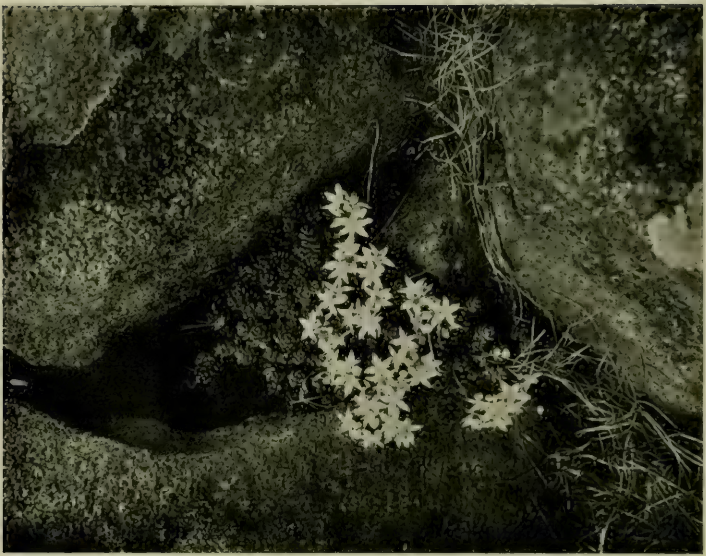

Fig. 124.—Isle of May. Sedum anglicum growing in a crevice of lichen-covered rocks. This plant is abundant on the island.

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E. A. Schäfer. Proc. Roy. Soc. Edin., vol. , 1902, pp. .

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